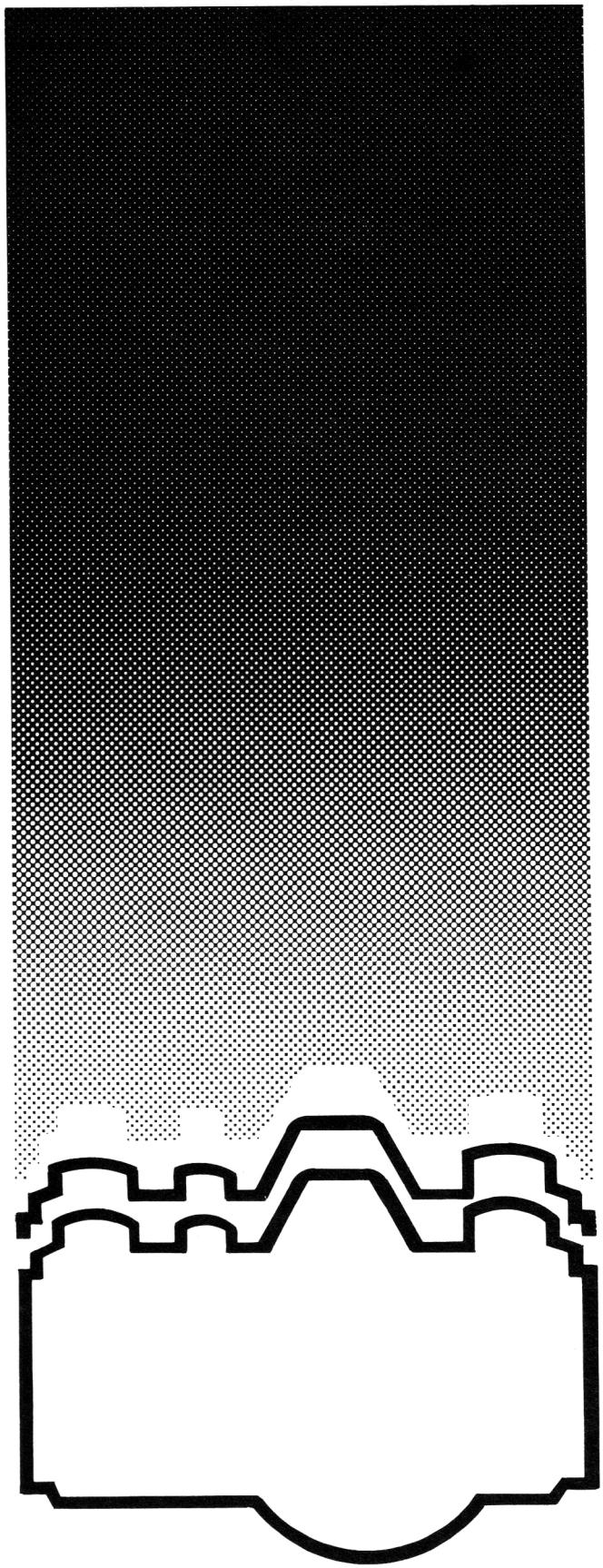

The
Simple-
Escapement
Retard



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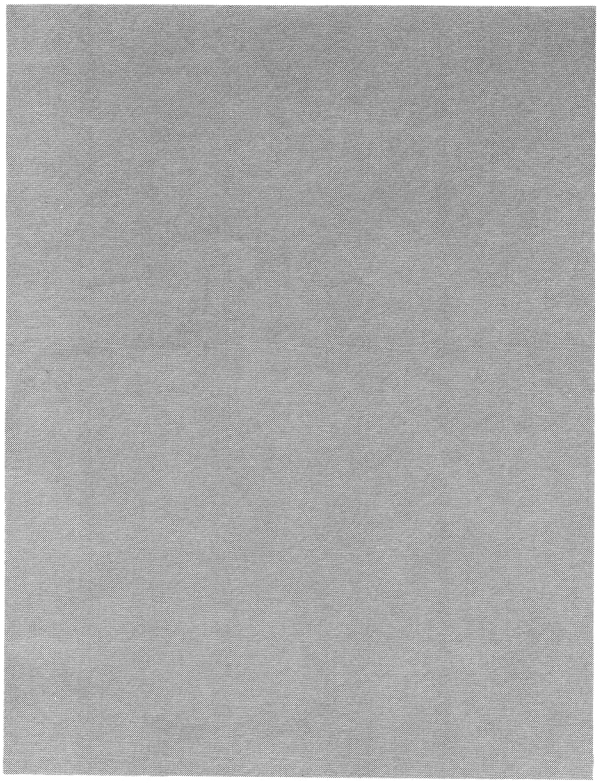
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The Simple-Escapement Retard

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SIMPLE AND COMPLEX RETARDS

You've learned how a mechanical retard provides a range of shutter speeds. Remember, the retard delays the movement of the main lever while the blades are fully open. Since the retard governs the shutter speeds, many service manuals use the term "governor" rather than "retard."

An escapement, you'll recall, is a specific type of retard — a retard that uses a star wheel and pallet to slow down the rotation of the gear train. A simple escapement can provide a limited range of shutter speeds. By increasing the complexity of the escapement, the manufacturer can extend the speed range.

To facilitate your study of blade-type shutters, we've established two categories according to the type of escapement:

1. simple-escapement retards
2. complex-escapement retards

The main difference between the two types lies in the speed range. A simple-escapement retard provides only a few shutter speeds — typically, three or four settings. By contrast, the complex-escapement retard provides a full range of shutter speeds.

In this lesson, you'll study the simple-escapement-retard shutter. Typically, the slowest speed such a shutter can provide is around 1/30 second. The fastest shutter speed may be around 1/250 second.

Your study of the simple-escapement-retard shutter should give you a working knowledge of blade-type shutters along with the confidence to tackle actual repairs. Also, you'll gain the practice and background you need to work on the complex-escapement shutters covered later in your program.

COMPUR AND GAUTHIER SHUTTERS

Most of the quality blade-type shutters were once made in Germany. Compur and Gauthier (pronounced "Goth'-ee-ay") became the principal manufacturers. The Japanese-made blade-type shutters which later became predominant closely followed either the Compur or the Gauthier design.

In fact, the Compur and Gauthier designs have been so prevalent that we can consider them to be basic types — the Compur-type shutter and the Gauthier-type shutter. Thus a Compur-type shutter isn't necessarily made by Compur; rather, it can be any shutter that follows the Compur design. The Compur-type shutter provides a good example of a complex-escapement system.

Gauthier has manufactured a wider variety of shutters. Although most Gauthier shutters follow the same basic design, they range in features. You'll find the simple-escapement Gauthier (or Gauthier-type) shutters in inexpensive rangefinder-type cameras. The complex-escapement Gauthier shutters rival the Compurs for use in professional-quality equipment.

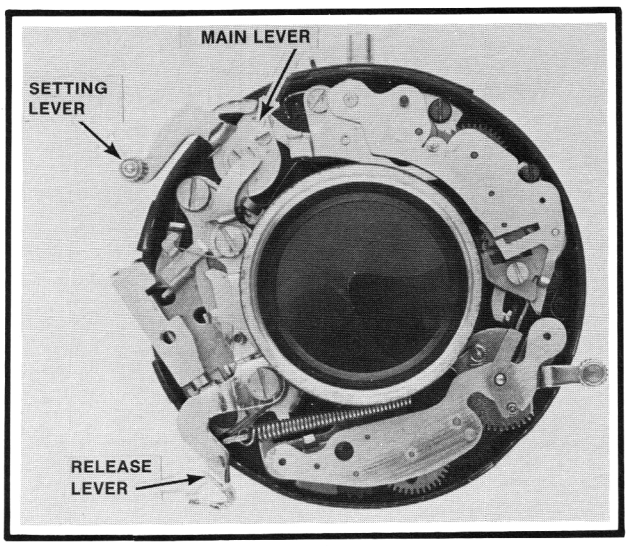


Figure 1 **Prontor—S**

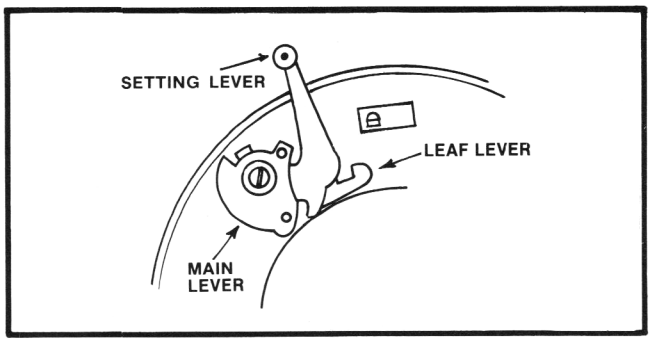


Figure 2 **Shutter released**

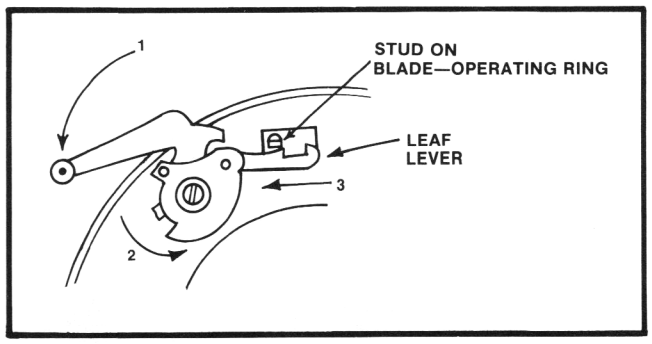


Figure 3 **During cocking cycle**

The model name "Prontor" identifies a Gauthier-made complex-escapement shutter, Fig. 1. Simple-escapement Gauthier models include the Vario and the Pronto. But you can always spot a Gauthier-type shutter by the main-lever/leaf-lever design.

Notice that the setting lever in Fig. 1 is an extension of the cam-shaped main lever. Actuating the setting lever rotates the main lever counterclockwise to the cocked position.

The leaf lever attaches to the main lever, Fig. 2. However, the leaf lever is a separate piece; it's free to pivot around the pin which holds it to the main lever. The main lever always drives the leaf lever — both in the blade-opening and blade-closing directions.

As you move the setting lever in the direction of arrow 1, Fig. 3, the main lever rotates as shown by arrow 2. And the main lever draws the leaf lever in the direction of arrow 3. The leaf-lever spring (not shown) now pushes the leaf lever against the stud on the blade-operating ring. But as yet the blade-operating ring doesn't move; the blade-operating-ring stud simply cams the spring-loaded leaf lever aside.

Fig. 4 shows the parts in the cocked position. Here, the notch in the leaf lever drops over the blade-operating-ring stud. A latch now holds the main lever against the rotating force of the mainspring (under the main lever and not yet visible).

Releasing the shutter disengages the latch that holds the main lever. The mainspring then drives the main lever in the direction of arrow 1, Fig. 5. And the main lever drives the leaf lever in the direction of arrow 2. The leaf lever now rotates the blade-operating ring clockwise to open the shutter blades.

As the main lever continues rotating clockwise, it draws the leaf lever in the opposite direction — opposite arrow 2 in Fig. 5. Consequently, the leaf lever pulls the blade-operating-ring stud from right to left. The right-to-left movement rotates the blade-operating ring counterclockwise to close the blades. As you can see, the main lever positively drives the blade-operating ring in both the opening and closing directions.

Where does the escapement come in? When the main lever reaches the full-open position, Fig. 5, its lug comes

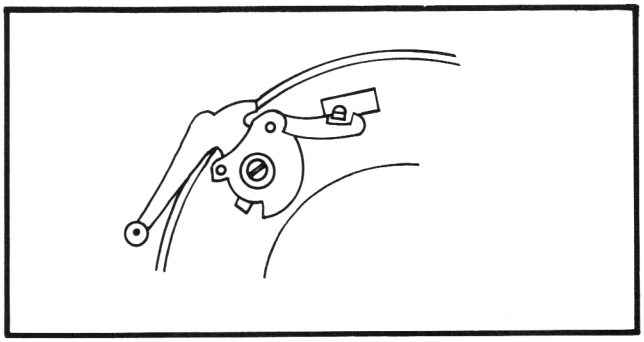


Figure 4 **Shutter cocked**

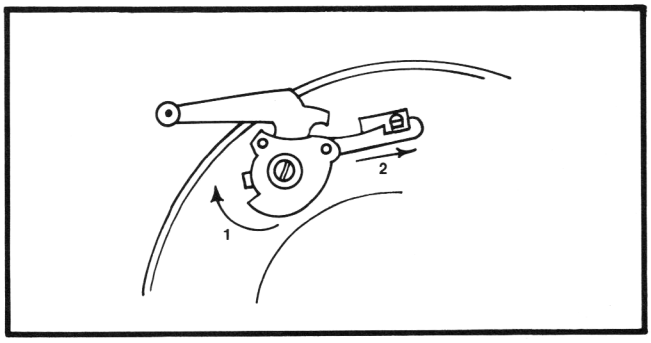


Figure 5 **Release cycle--blades open**

against the retard lever, Fig. 6. Now the main lever must push its way through the retarding effect of the escapement before completing its clockwise rotation.

You may have noticed that the shutter in Fig. 6 actually has two escapements. One escapement intercepts the main lever to provide the different shutter speeds. The second escapement provides the self-timer feature — a delay before the blades actually open.

It's typical for modern shutters to have two escapements — one for the shutter speeds and one for the self-timer. Thus we normally distinguish between the two escapements according to their functions:

1. the speeds escapement (or speed governor)
2. the delayed-action escapement (or self-timer)

As you now study a representative Gauthier shutter, you'll see how the two escapements perform their functions. The Pronto Silette, Fig. 7, provides a good example for all the actions we've discussed.

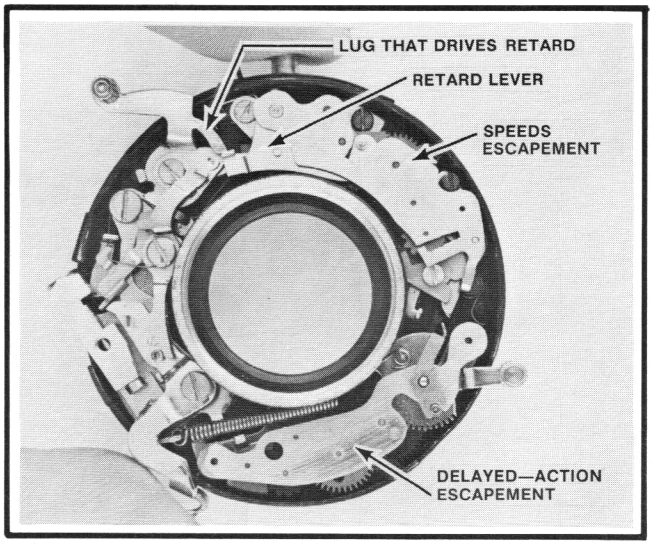


Figure 6

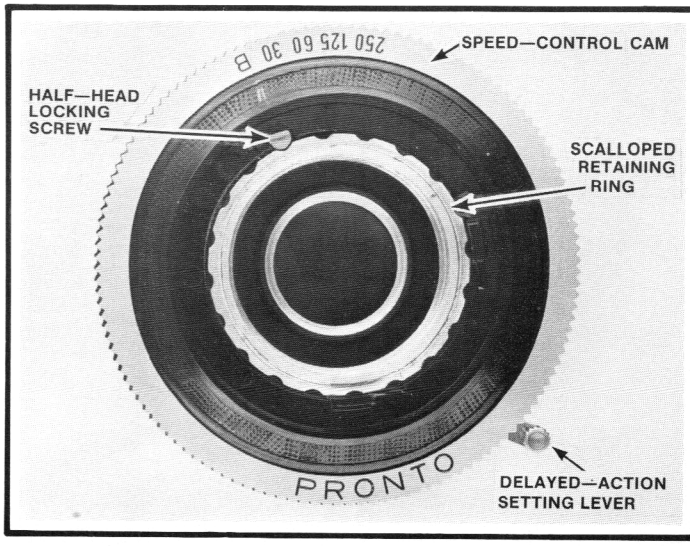


Figure 7

TEST-YOURSELF QUIZ #1

1. In a Gauthier-type shutter, the main lever rotates in a clockwise direction to open the shutter blades. What direction does the main lever rotate to close the shutter blades? CLOCKWISE
2. The speeds escapement is also called the SLOW SPEED GOVERNOR
3. The delayed-action escapement is also called the SELF-TIMER
4. In a Gauthier-type shutter, what spring provides the power to close the shutter blades?
   a. leaf-lever spring
   (b) mainspring
5. The delay provided by the delayed-action escapement is applied
   (a) before the blades start to open.
   b. after the blades reach the full-open position.
6. Using a separate piece of paper, draw a cycle-of-operations of the parts illustrated in Fig. 5. Include spring actions where applicable, even though the springs aren't shown.

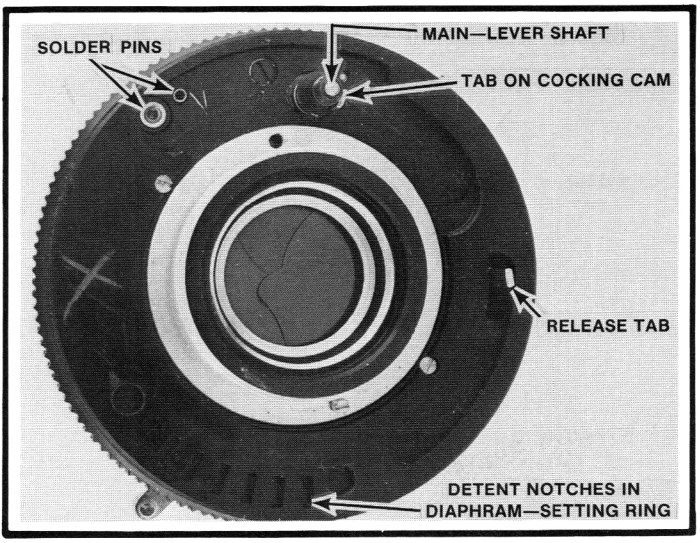


Figure 8

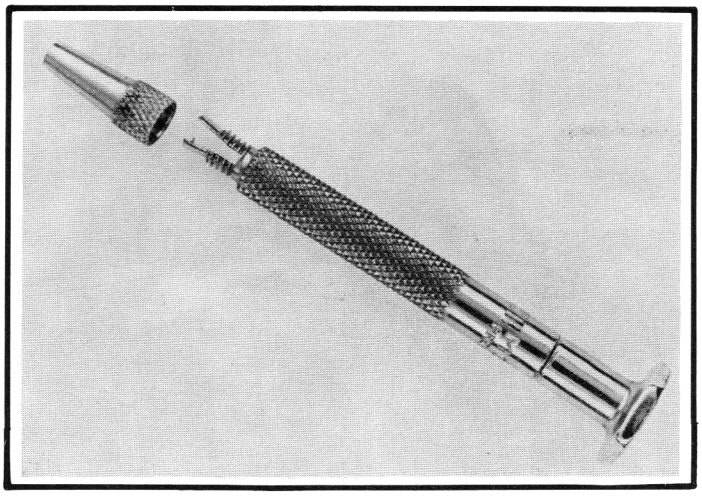


Figure 9

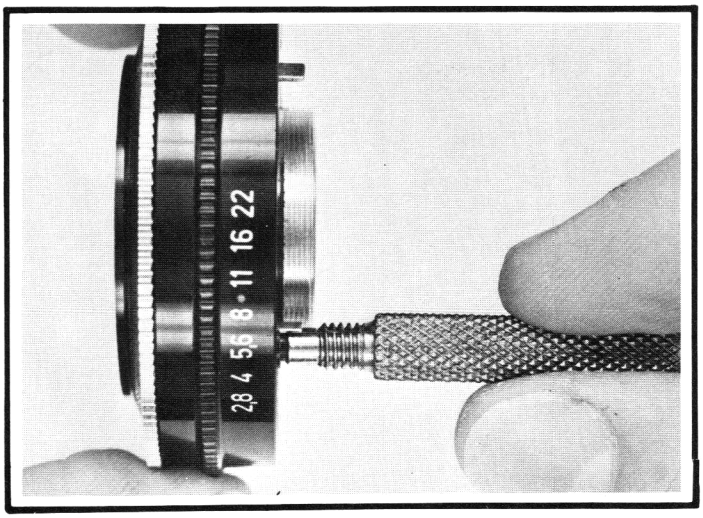


Figure 10

FEATURES OF THE PRONTO SILETTE SHUTTER

From the calibrations on the speed-control cam, Fig. 7, you can see that the Pronto has a limited speed range — 1/30 through 1/250 and bulb. Also notice that the Pronto has no external setting lever. Nor is there an external release lever. That's because the cocking and releasing actions couple to the camera controls.

A shaft on the back of the main lever extends through the shutter housing, Fig. 8. This shaft couples to the camera's cocking mechanism. So, when you advance the camera's wind lever to advance the film, you're simultaneously cocking the shutter.

The tab at the back of the shutter is part of the release system. Pushing down the camera's release button depresses the tab to release the shutter.

With the shutter removed from the camera, it's a little difficult to cock the main lever. However, you can cock the shutter by rotating the main-lever shaft. Locate the vertical tab on the **cocking cam**, Fig. 8; the tab on the cocking cam keys to the camera's wind mechanism. By placing your thumbnail against the tab, you can rotate the main-lever shaft in a clockwise direction. The shaft should then latch in the cocked position.

Alternately, you can make a "special tool" to cock the shutter. One tool which works well is a collet-type screwdriver, Fig. 9. Remove the collet and slightly spread the two jaws — until the jaws will fit over the main-lever shaft, Fig. 10. You can now use the screwdriver handle to cock the shutter. Release the shutter by pushing the release tab, Fig. 8.

Try cocking and releasing the shutter at the different shutter-speed settings. With the shutter removed from the camera, though, you may not have an index to use in aligning the shutter-speed calibrations. Some shutters have a depth-of-field scale on the cover plate; you can then use the center of the depth-of-field scale as your shutter-speed index. However, if your shutter has no markings on the cover plate, align the desired shutter-speed calibration with the half-head locking screw, Fig. 7.

You can feel the click-stops as you rotate the speed-control cam. But the diaphragm-setting ring rotates freely — it has no detented positions. Again, part of the system — in this case, the detent — remains with the camera. Locate the series of notches at the back of the diaphragm-setting ring, Fig. 8; these notches ride against the camera-body detent to provide the click-stops.

Also check the operation of the self-timer. Cock the shutter. Then cock the delayed-action mechanism — just turn the **delayed-action setting lever**, Fig. 7, as far as it will go in a clockwise direction. When you actuate the release tab, the shutter should not release. But the delayed-action escapement should start running. After the self-timer delay of around seven seconds, the shutter should release.

There's another feature of the Pronto that you'll find in practically all modern shutters — built-in flash synchronization. When the shutter opens, it closes a pair of internal contacts to fire a flash unit.

The actual flashcord terminal remains in the camera body. Wires connect the flashcord terminal to the two solder pins at the back of the shutter, Fig. 8. Although you'll later study flash systems in detail, you should understand for now that the shutter provides X synchronization for electronic flash. The flash contacts close when the blades reach the full-open position.

REMOVING THE SPEED-CONTROL CAM

Before you remove the speed-control cam, rotate it several times to the different settings. Try to get a "feel" for the amount of pressure required to rotate the speed-control cam. The **scalloped retaining ring**, Fig. 7, controls the amount of pressure — the more you tighten the scalloped retaining ring, the greater the pressure required to rotate the speed-control cam.

You must unscrew the scalloped retaining ring to disassemble the shutter. That's why you should first attempt to get a feel for the proper turning pressure. On reassembly, tighten the scalloped retaining ring until the speed-control cam has the same "feel."

NOTE: The amount of pressure on the speed-control cam may not seem all that critical. But the customer will probably notice any difference. Of course, it's difficult to retain the exact pressure after reassembly. However, if the speed-control cam feels a little tighter, the customer tends to think that you've improved the shutter's condition; you've "tightened things up." If the speed-control cam feels looser than it did prior to the repair, the customer may think you've done a sloppy job.

The half-head locking screw locks the scalloped retaining ring to prevent it from loosening. Using a screwdriver of the proper size, rotate the half-head locking screw 180° — until the screwhead clears the scalloped retaining ring, Fig. 11.

You can now unscrew the scalloped retaining ring. But, if you use a metal tool, there's a danger of scratching the cover plate. It's best to use a wood or plastic tool. Push the tool against one of the notches to start the scalloped retaining ring in a counterclockwise direction. Then unscrew the scalloped retaining ring and lift off the cover plate, Fig. 12.

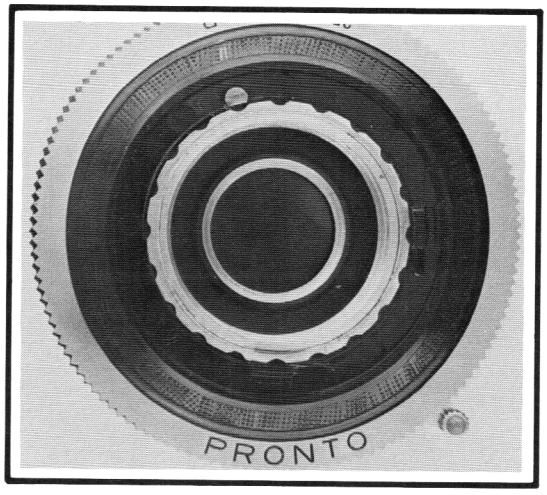


Figure 11

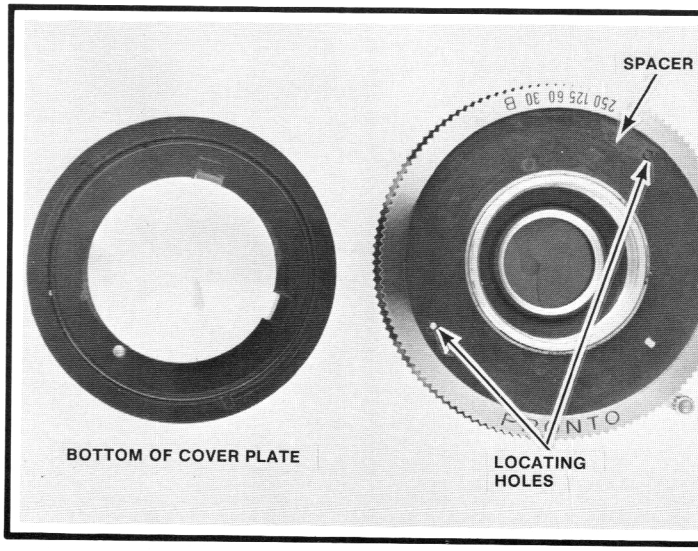


Figure 12

Your shutter may have a plastic cover plate. Or the cover plate may be metal (anodized aluminum). With both types, a thin black spacer fits between the cover plate and the speed-control cam, Fig. 12. Check your shutter to see if the spacer has remained on top of the speed-control cam as shown in Fig. 12. If not, the spacer may have stuck to the bottom of the cover plate.

Two of the three holes in the spacer serve as locating holes; they fit over pins in the shutter assembly, Fig. 12. The cover plate has two locating slots which also fit over the pins. For practice, you might try replacing the spacer and the cover plate at this time. First seat the spacer, aligning the two locating holes over the pins, Fig. 12.

Next rotate the speed-control cam fully clockwise — the bulb setting. Place the cover plate on top of the spacer. Now, while applying slight downward pressure, rotate the cover plate until the half-head locking screw aligns with the "B" calibration on the speed-control cam. You should feel the cover plate click into place as its locating slots drop over the pins.

FUNCTIONS OF THE SPEED-CONTROL CAM

Again remove the cover plate and lift off the spacer. You can then examine the speed-control cam, Fig. 13. Locate the cam-shaped slots which control the bulb lever, the retard lever, and the pallet lever.

The large cutout near the outer edge of the speed-control cam provides the detent action — the click-stops which position the speed-control cam precisely at each setting. A spring-loaded **detent lever** rides against a row of five notches, Fig. 13. As you rotate the speed-control cam, note how the pin on the detent lever clicks into the notches.

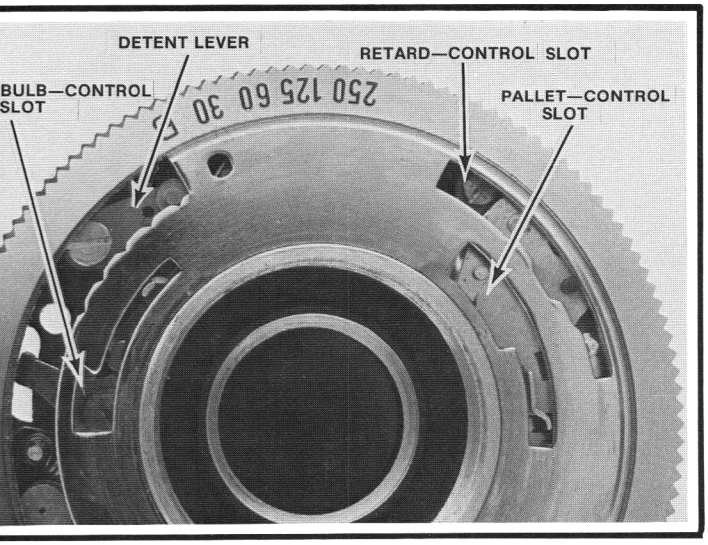


Figure 13

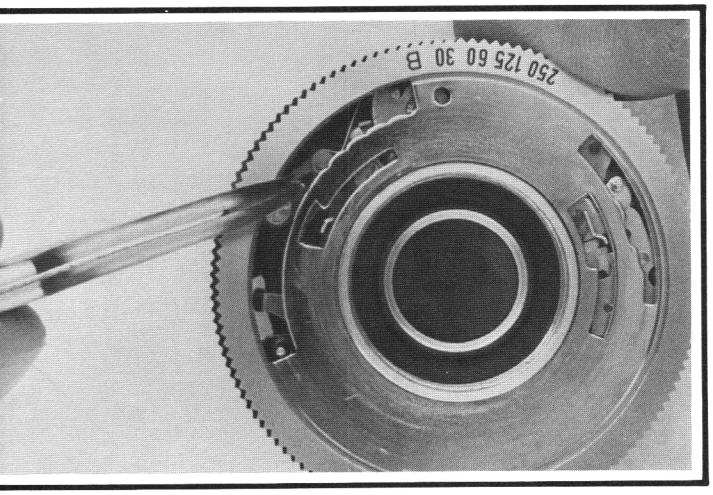


Figure 14

CAUTION: Be careful to avoid lifting the speed-control cam as you set the different shutter speeds — the detent lever may then slip under the speed-control cam. In that case, the speed-control cam won't seat fully. To reseat the speed-control cam, first make sure the shutter is released. Also, rotate the speed-control cam fully clockwise to the bulb setting (you'll see why in a moment), Fig. 14. Now insert the points of your closed tweezers into the detent-lever hole, Fig. 14. Pull the detent lever against its spring action (toward the outside of the shutter) while applying slight downward pressure to the speed-control cam. The speed-control cam should then seat fully.

Next examine the slot that controls the bulb-lever, Fig. 15. Remember that the bulb lever holds open the shutter for as long as you keep the release tab depressed. Letting up the release tab disengages the bulb lever. The main lever then completes its release rotation to close the shutter blades.

The speed-control cam decides whether or not the bulb lever can move into position to hold open the shutter. Notice that the bulb-control slot has one wide end; the rest of the slot is narrow. At the bulb setting, the wide end of the slot sits over the control tab of the bulb lever, Fig. 15. So, once you release the shutter, the bulb lever has free movement.

Now set the speed-control cam to 1/30 second, Fig. 16. Note how the speed-control cam moves a narrow section of the bulb-control slot over the bulb-lever control tab. When you release the shutter, the bulb-control slot prevents the bulb lever from moving.

NOTE: You can now see why you should only replace the speed-control cam at the bulb setting. Here, the wide section of the bulb-control slot clears the bulb-lever control tab, Fig. 15. At any other position, a solid portion of the speed-control cam may come on top of the bulb-lever control tab during reassembly. The speed-control cam may then bend the bulb-lever control tab.

The remaining two slots in the speed-control cam govern the retard lever and the pallet lever. Looking through the retard-control slot, locate the control pin on the retard lever, Fig. 16. Then, while watching the control pin, cock the shutter. Note how the control pin moves toward the center of the shutter until it comes against the cam edge of the retard-control slot.

As the control pin moves toward the center of the shutter, the retard lever swings into position to engage the main lever. The cam edge of the retard-control slot determines how far the retard lever can move. More movement during the cocking cycle means that the retard lever stays engaged with the main lever for a longer period of time during the release cycle.

Compare the amount of retard-lever travel at 1/30 with the amount of travel at bulb, Fig. 15. At bulb, the retard lever actually travels further during the cocking cycle. The retard lever then remains engaged with the main lever for a longer period of time — more retard action for a slower shutter speed. The additional retard at bulb assures that the bulb lever always has time to positively engage the main lever.

Can you now see why you should replace the speed-control cam with the shutter released? The retard-lever control pin then sits away from the cam edge. Thus there's no chance of damage to the control pin when you replace the speed-control cam.

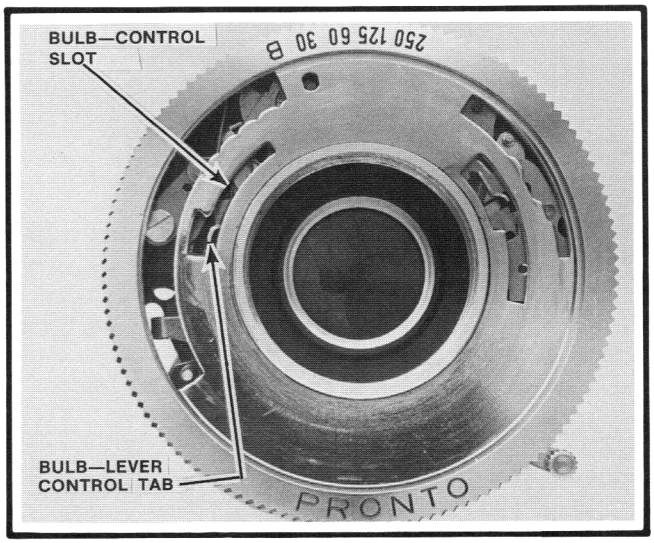
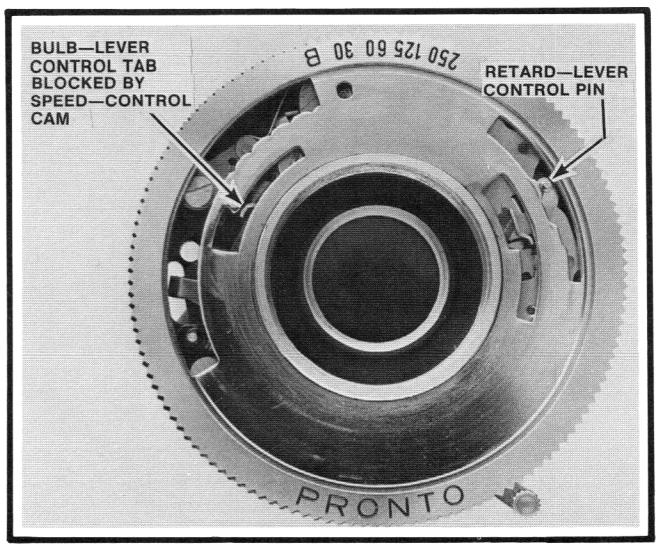


Figure 15 **Bulb setting**

Figure 16 **1/30-second setting**



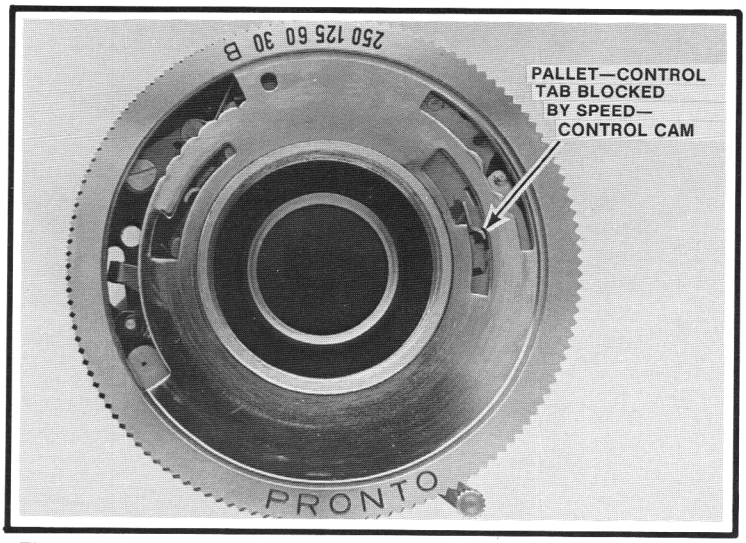


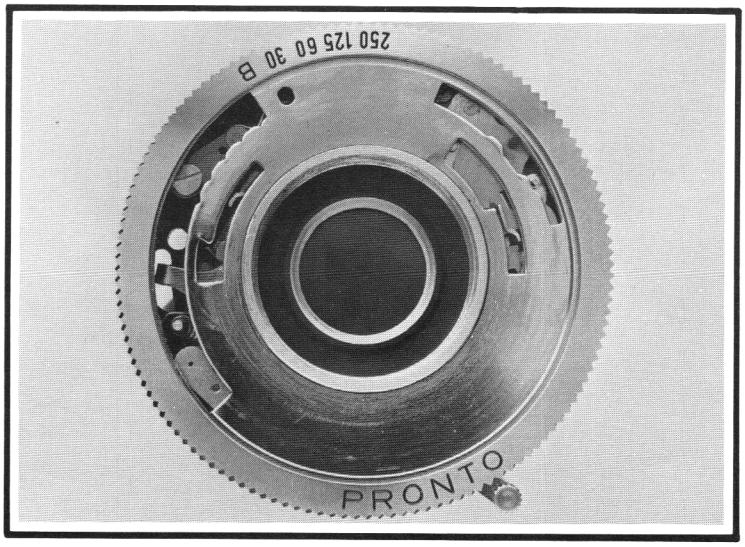
Figure 17 **1/60-second setting**

At the 1/60-second setting, Fig. 17, the retard lever has more travel than it does at 1/30 second. This may seem backwards — shouldn't the retard lever have more travel at the slower shutter speed? If the Pronto depended strictly on the amount of retard-lever stroke for the different speeds, the answer would indeed be yes. But one other action takes place at 1/60 — the pallet-control slot disengages the pallet, Fig. 17.

Disengaging the pallet means that the escapement offers less resistance to the rotation of the main lever. So, even though the retard lever has a greater stroke, there's less total retard action. Locate the pallet-control tab in Fig. 17. The pallet-control tab is part of the pallet-control lever. At 1/60, the narrow section of the pallet-control slot blocks the movement of the pallet-control tab.

Compare the action with that at 1/30, Fig. 16. At 1/30, the pallet-control slot clears the pallet-control tab. Notice that the pallet-control tab doesn't move as you cock the shutter.

Figure 18 **1/125-second setting**



But, when you release the shutter, the pallet-control tab moves toward the inner edge of the pallet-control slot. This movement brings the pallet into engagement with the star wheel.

Now take another look at 1/60, Fig. 17. Here, the corner of the pallet-control slot blocks the movement of the pallet-control tab. The pallet remains disengaged at 1/125 second, Fig. 18. And the retard-control slot reduces the retard-lever stroke for a faster shutter speed.

At 1/250, Fig. 19, the speed-control cam holds both the retard lever and the pallet completely disengaged. The shutter speed now depends entirely on how fast the main lever can drive the blades.

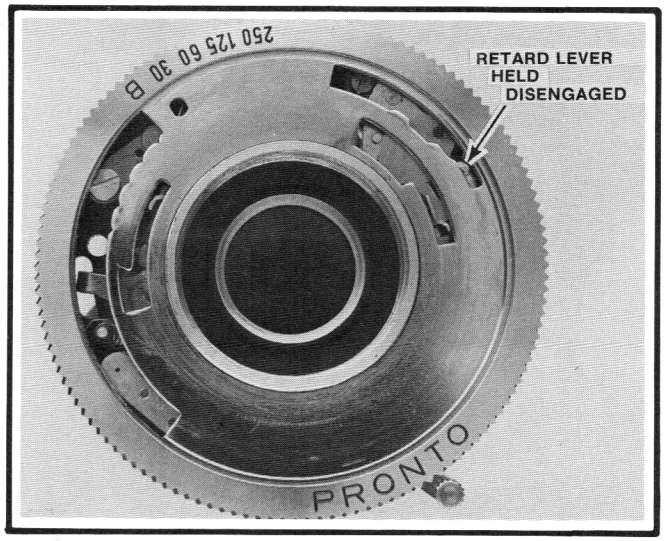


Figure 19 **1/250-second setting**

Here's a summary of the speed-control-cam actions at the different settings:

Setting	Bulb Lever	Retard Lever	Pallet
Bulb	Engaged	Maximum travel	Engaged
1/30	Disengaged	Partial travel	Engaged
1/60	Disengaged	Maximum travel	Disengaged
1/125	Disengaged	Partial travel	Disengaged
1/250	Disengaged	Disengaged	Disengaged

TEST-YOURSELF QUIZ #2

1. When you replace the speed-control cam in the Pronto, what shutter-setting position should you use? BULB (bulb, 1/30, 1/60, 1/125, 1/250). Should the shutter be cocked or released? RELEASED.
2. The Pronto retard lever swings into position to intercept the main lever
   (a.) during the cocking cycle
   b. during the release cycle
3. The further the retard lever moves during the cocking cycle, the MORE (more, less) the retard action.
4. The pallet in the Pronto moves into engagement with the star wheel
   a. during the cocking cycle
   (b.) during the release cycle
5. What is the slowest shutter speed in the Pronto at which the pallet does not engage the star wheel? 1/60
6. At what instantaneous shutter speed in the Pronto does the retard lever have the largest stroke? 1/60

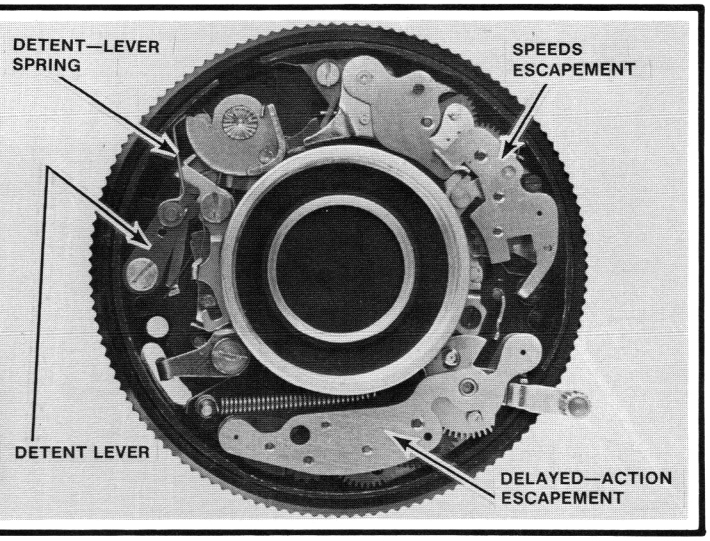


Figure 20

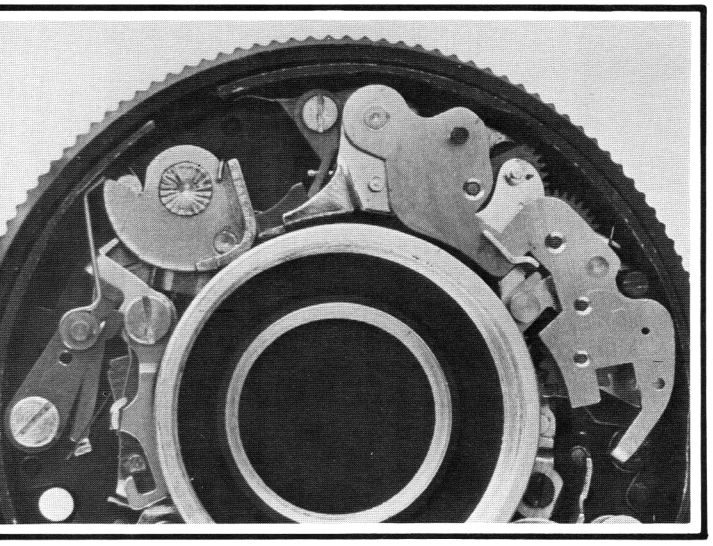


Figure 21

INTERNAL OPERATION OF THE PRONTO

Lift off the speed-control cam. You can now study the shutter operation. But before you cock and release the shutter, it's a good idea to remove the detent-lever spring, Fig. 20. Otherwise, the spring may decide to fly out when you least expect it.

Take a close look at the detent-lever spring; there are a couple of variations. Fig. 21 shows one type. Here, the long end of the detent-lever spring rests against the inside of the shutter housing. The detent-lever spring then coils around a groove at the base of the detent-lever control pin. And the short end hooks against a spring-hooking lug at the end of the detent lever.

The second type of detent-lever spring doesn't use the spring-hooking lug. Instead, the detent lever has a spring-hooking notch cut in one edge, Fig. 22. A straight section of the detent-lever spring rests in the groove at the base of the detent-lever control pin. One end of the detent-lever spring then hooks to the spring-hooking notch.

With either type, use your tweezers to lift the long end of the detent-lever spring clear of the shutter housing. Then disconnect the short end of the detent-lever spring from the detent lever. For reassembly reference, remember that the detent-lever spring must push the detent lever toward the center of the shutter.

You can now safely operate the shutter. Cock the shutter while watching the counterclockwise rotation of the main lever, Fig. 22. In the cocked position, the **inner-release lever** latches the main lever, Fig. 23.

Like most blade-type shutters, the Pronto has two release levers. The inner-release lever is the part that actually latches the main lever, Fig. 23. When you actuate the release tab at the back of the shutter, the **outer-release lever**, Fig. 24, pushes the inner-release lever out of engagement. The release tab is just an extension arm of the outer-release lever.

The shutter should now deliver bulb action with full retard. With the speed-control cam removed, there's nothing to restrict the movements of the bulb lever, the retard lever, or the pallet-control lever. You can now see how these levers perform their jobs.

During the cocking cycle, the spring-loaded retard lever moves from the position shown in Fig. 22 to that shown in Fig. 23. In Fig. 22, the main lever holds the retard lever. But, as the main lever rotates counterclockwise, it allows the retard lever to move. A spring inside the escapement then drives the retard lever to the ready position, Fig. 23 (the spring that drives the retard lever is actually on the first-gear segment of the speeds escapement).

Remember, the speed-control cam determines how far the retard-lever control pin, Fig. 23, can move toward the center of the shutter. That movement, in turn, determines how far the end of the retard lever can swing into the main-lever path. With the speed-control cam removed, the retard

lever always moves its maximum distance — slightly further than it moves at any shutter-speed setting.

During the release cycle, the main lever first drives open the shutter blades. The **retard-drive lug** on the main lever then strikes the retard lever, Fig. 24. Now the main lever must push its way through the resistance of the speeds escapement.

NOTE: You can more easily observe the main-lever operation by holding the main-lever shaft as you release the shutter. Allow the main lever to rotate slowly in the release direction, Fig. 24.

The main lever continues rotating clockwise with the blades fully open. When the main lever rotates far enough, the end of the retard-drive lug slips past the end of the retard lever. Now the main lever can freely complete its rotation to close the shutter blades.

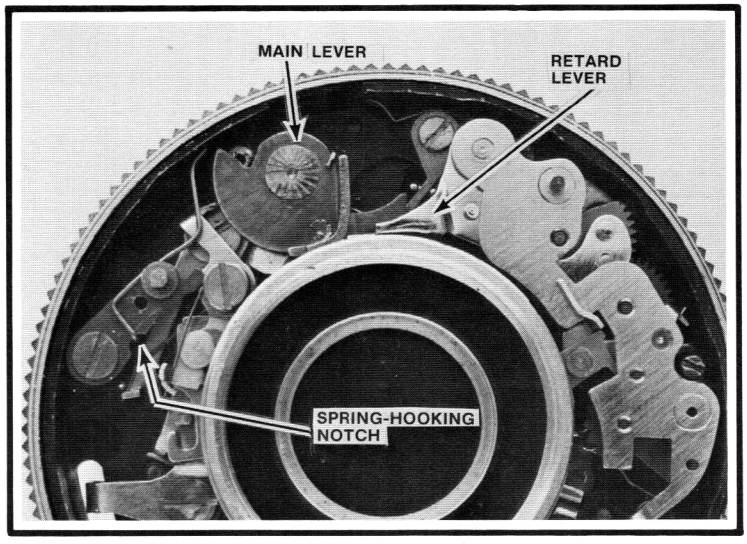


Figure 22 Shutter released

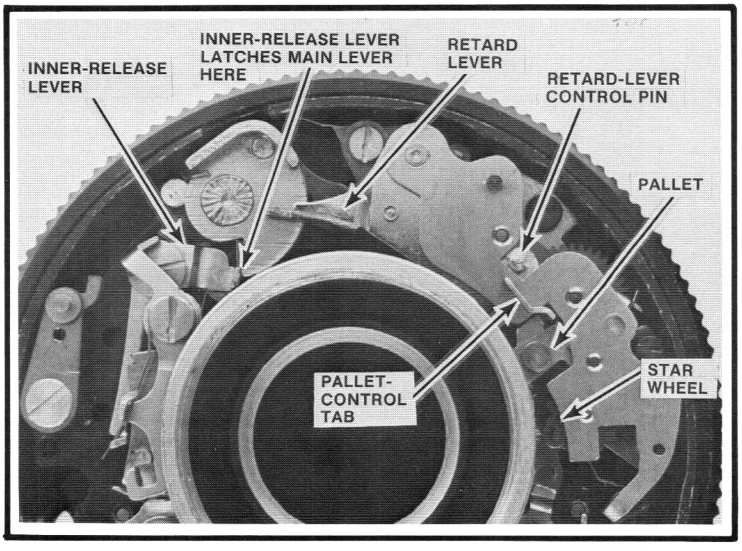


Figure 23 Shutter cocked

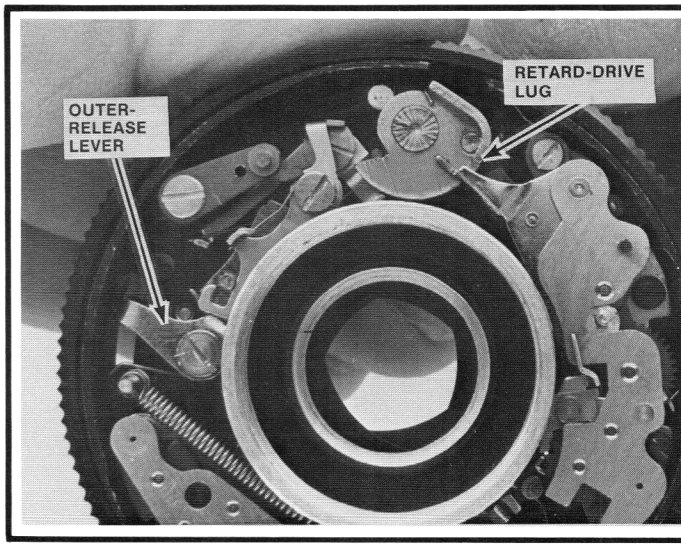


Figure 24

However, if you keep the release tab depressed, the bulb lever latches the main lever — before the blades start to close, Fig. 25. The bulb lever latches the same main-lever lug that the inner-release lever had previously engaged. Since the main lever can't complete its rotation, the blades remain open.

When you let up the release tab, the outer-release lever disengages the bulb lever. Locate the U-shaped end of the bulb lever, Fig. 25. A pin on top of the outer-release lever fits within the U-shaped section. So, as the outer-release lever turns clockwise, Fig. 25, the pin pushes the latching end of the bulb lever away from the main lever.

The pin coupling provides positive engagement between the bulb lever and the main lever. Try watching the pin action during the release stroke. As the outer-release lever pivots counterclockwise, the pin moves into the U-shaped end of the bulb lever. Now the pin holds the bulb lever in firm engagement with the main lever. Were it not for the pin coupling, the main lever would simply knock the bulb lever aside.

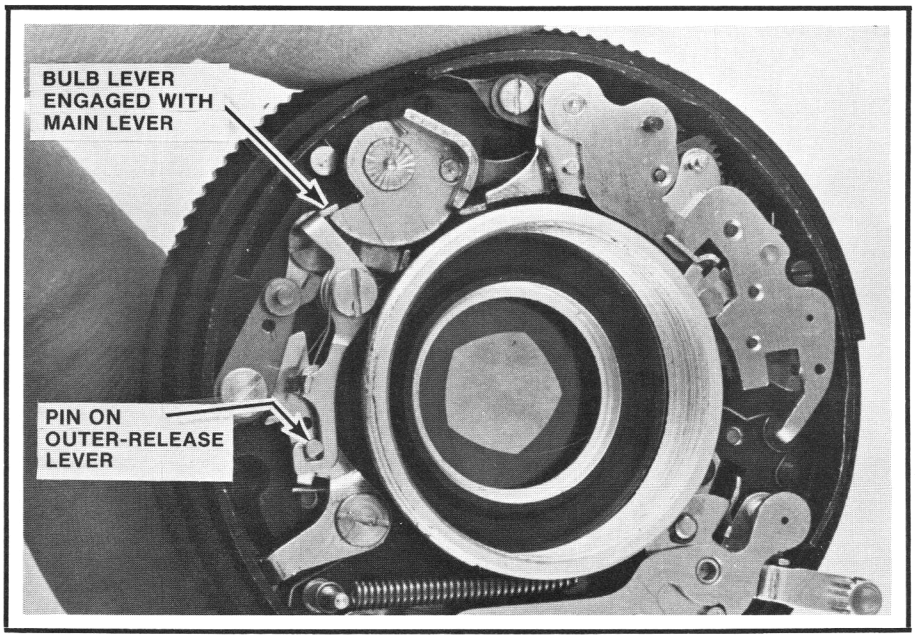


Figure 25

SHUTTER-SPEED EXPERIMENTS

By performing a few experiments, you can get a better idea as to how the speed-control system works. Cock the shutter. Then push the retard-lever control pin, Fig. 23, toward the outside of the shutter.

Notice how you've just shortened the stroke of the retard lever. The further you push the control pin, the shorter the retard-lever stroke — and the faster the resulting shutter speed. Why? The main lever stays engaged with the retard lever for a shorter period of time.

Positioning the retard-lever control pin simulates the function of the retard-control slot in the speed-control cam. To increase the retard-lever stroke, the speed-control cam allows the retard-lever control pin to move further toward the center of the shutter. The speed-control cam limits the movement of the retard-lever control pin to provide a shorter retard-lever stroke.

As you'll recall, there's one more part that affects the shutter speeds — the pallet, Fig. 23. Watch the pallet as you release the shutter. When the blades start to open, the pallet moves into engagement with the star wheel.

The pallet rapidly rocks back and forth as the star wheel rotates. You can even hear the "whirr" of the pallet working against the star wheel — that's the sound that identifies all pallet-controlled speeds.

A speeds escapement can provide one range of shutter speeds by varying the retard-lever stroke with the pallet engaged. Then, by disengaging the pallet, it's possible to obtain a second shutter-speed range — a range of faster speeds. The Pronto disengages the pallet at 1/60 to provide the high-speed range — 1/60 through 1/250.

Locate the control tab on the pallet-control lever, Fig. 23. Remember, this tab rides within the pallet-control slot of the speed-control cam. Again cock the shutter. Then place your tweezers against the inside edge of the pallet-control tab. By preventing the pallet-control tab from moving during the release cycle, you're simulating the action of the speed-control cam at 1/60.

Now, while still holding the pallet-control tab, release the shutter. You should be able to visually detect the difference in the amount of retard. The main lever runs through the retard more quickly.

Remember that the pallet has only two positions — fully engaged or fully disengaged. As is typical, the Pronto does not vary the depth of pallet engagement to effect different shutter speeds. However, in many shutters, you can change the depth of pallet engagement as a shutter-speed adjustment. Increasing the depth of engagement between the pallet and the star wheel results in a slower shutter speed; decreasing the depth of engagement results in a faster shutter speed. You'll see examples of pallet adjustments as you study the complex-escapement shutters.

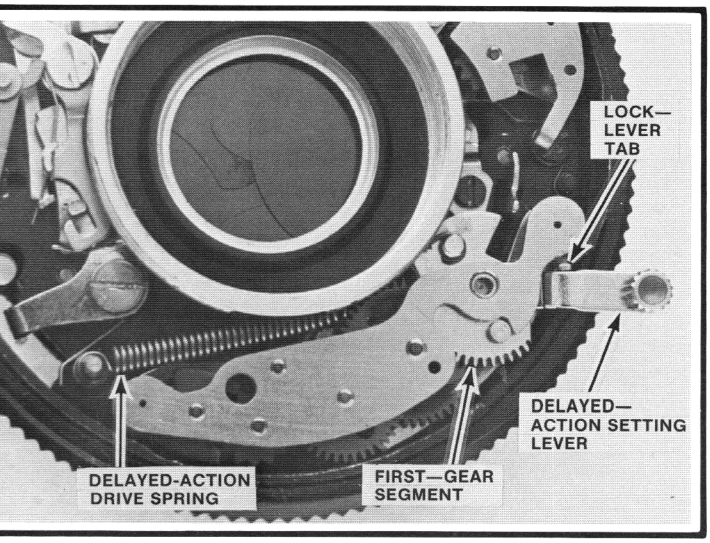


Figure 26

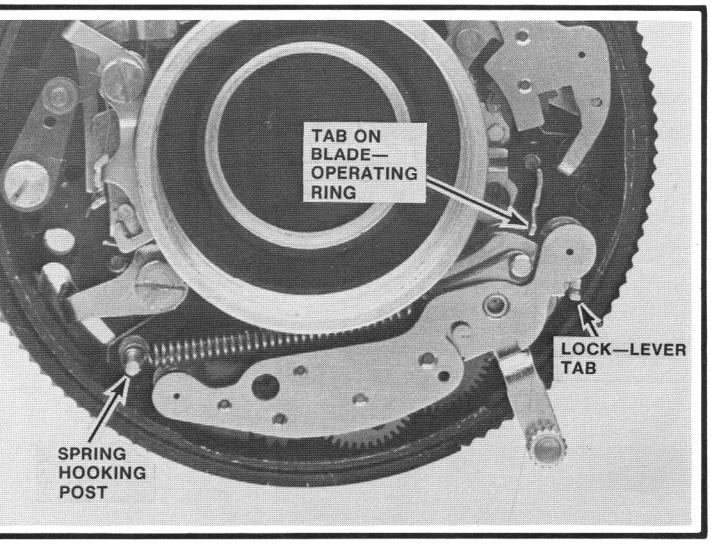


Figure 27

OPERATION OF THE PRONTO SELF-TIMER

The self-timer design in the Pronto is typical of Gauthier-type shutters. Cock the shutter. Then charge the delayed-action escapement; just turn the delayed-action setting lever, Fig. 26, in a clockwise direction.

Notice that the delayed-action setting lever is part of a gear in the delayed-action escapement — the **first-gear segment**, Fig. 26. The **delayed-action drive spring**, Fig. 26, hooks to the first-gear segment. So, as you charge the delayed-action escapement, you're tensioning the delayed-action drive spring, Fig. 27.

A solid portion of the first-gear segment now comes into the path of a tab on the blade-operating ring, Fig. 27. Watch the tab on the blade-operating ring as you release the shutter. You should see the blade-operating-ring tab move a slight distance. But, before the blade-operating ring can rotate far enough to open the blades, the tab strikes the first-gear segment.

Simultaneously, the delayed-action escapement starts running. The slight initial movement of the blade-operating ring disengages a latch inside the delayed-action escapement. As a result, the delayed-action drive spring starts pulling the first-gear segment in a counterclockwise direction, Fig. 27.

The first-gear segment continues to rotate until its slot reaches the tab on the blade-operating ring, Fig. 26. Now the blade-operating-ring tab can pass into the slot. The blade-operating ring then completes its clockwise rotation, driving open the shutter blades.

As yet, it's a little difficult to observe the latching and releasing actions of the delayed-action escapement. But you can see the tab on the **delayed-action lock lever**, Fig. 27. Notice that, in the released position, the delayed-action setting lever comes against the lock-lever tab, Fig. 26. Here, the delayed-action setting lever holds the delayed-action lock lever disengaged.

The delayed-action setting lever moves away from the lock-lever tab during the cocking stroke, Fig. 27. Now the delayed-action lock lever holds the delayed-action escapement in the charged position — against the tension of the delayed-action drive spring. In a moment, you'll be able to see how the initial rotation of the blade-operating ring disengages the delayed-action lock lever.

REMOVING THE DELAYED-ACTION ESCAPEMENT

To remove the delayed-action escapement, you'll have to take out the delayed-action drive spring. Consequently, the delayed-action escapement should be in the released position. That way, there's no tension on the delayed-action drive spring.

The coiled end of the delayed-action drive spring hooks to a lipped post on the mechanism plate, Fig. 27. Use your tweezers to carefully lift the spring loop up and off the post.

Now slide the delayed-action drive spring from left to right, Fig. 26 — until you can disconnect the other spring end from the post on the first-gear segment. With both spring ends disconnected, lift the delayed-action drive spring out of the shutter.

There are no screws holding the delayed-action escapement. But you can't as yet lift out the mechanism; the lip on the lens flange blocks the first-gear segment.

To clear the lip, partially cock the delayed-action escapement — advance the delayed-action setting lever until the first-gear segment is in the position shown in Fig. 28. Now grasp the delayed-action setting lever with your fingers. And lift the complete delayed-action escapement up and off the mechanism-plate post.

It's typical for an escapement to come out as a complete unit, Fig. 29. You'll rarely — if ever — have occasion to disassemble an escapement. What if the escapement has a broken part? You then replace the complete assembly, Fig. 29.

On the underside of the delayed-action escapement, Fig. 29, you can get a better look at the delayed-action lock lever. Remember, as you charge the delayed-action escapement, the delayed-action setting lever moves away from the lock-lever tab. The latching end of the delayed-action lock lever then drops into engagement with the pinion of the third gear, Fig. 29.

Now the delayed-action lock lever latches the gear train. And the first-gear segment can't rotate in a counterclockwise direction (as seen from the top, Fig. 28). But you can continue moving the delayed-action setting lever in the cocking direction because of a one-way clutch built into the second gear.

The delayed-action escapement remains latched until the blade-operating ring starts its release rotation. Then the tab on the blade-operating ring strikes the curved end of the delayed-action lock lever, Fig. 29. As a result, the latching end of the delayed-action lock lever swings away from the third-gear pinion. And the delayed-action drive spring can pull the first-gear segment in the release direction.

Try pushing in the curved end of the delayed-action lock lever, Fig. 29. You'll now find that you can turn the delayed-action setting lever in the release direction (clockwise as seen from the bottom, Fig. 29).

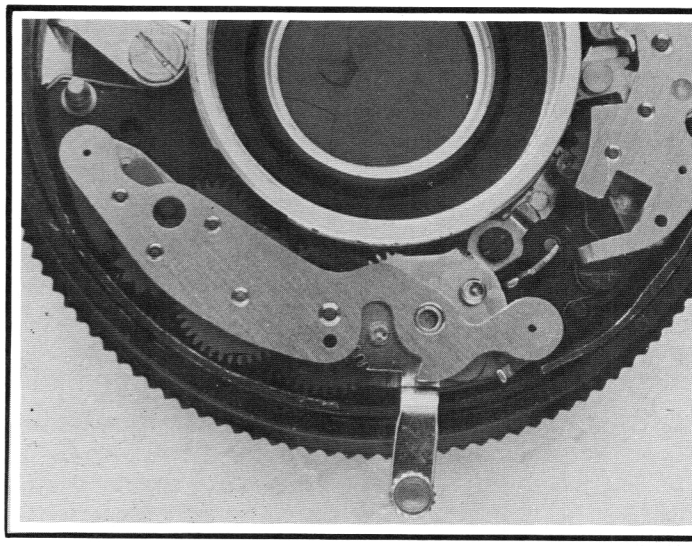


Figure 28

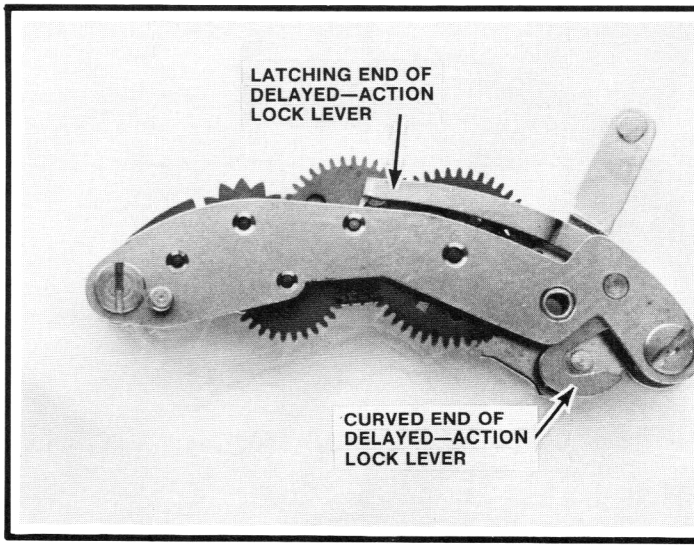


Figure 29

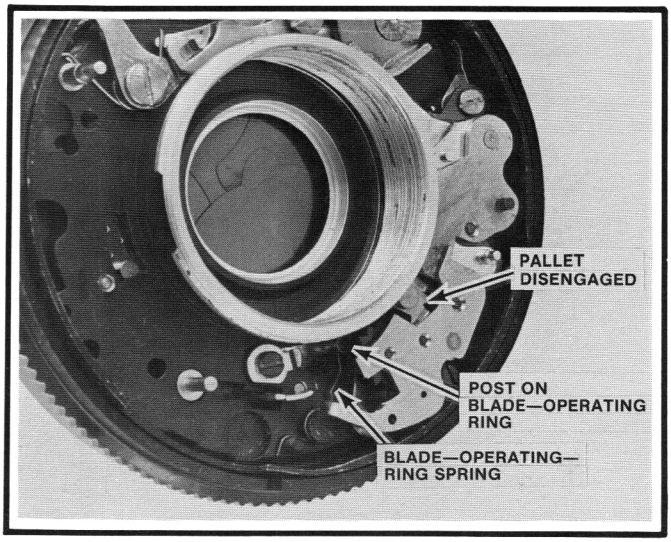


Figure 30

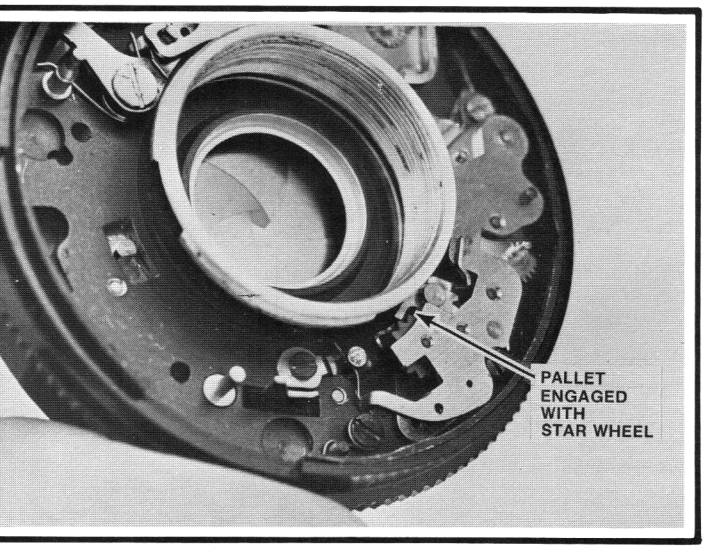


Figure 31 **Shutter open**

REMOVING THE SPEEDS ESCAPEMENT

The speeds escapement also comes out as a complete unit. However, before you remove the speeds escapement, there's one more action you should observe. Looking at the star-wheel end of the speeds escapement, locate the post on the blade-operating ring, Fig. 30. A spring — the **blade-operating-ring spring** — hooks to the post.

During the cocking cycle, the blade-operating-ring spring prevents the blades from opening. Remember, the leaf lever must slide across another tab on the blade-operating ring. Were it not for the blade-operating-ring spring, this sliding action would open the shutter blades.

The blade-operating-ring spring now holds the blade-operating ring in the blades-closed position. During the release cycle, the blade-operating ring rotates against the pressure of the blade-operating-ring spring. The mainspring must then overpower the blade-operating-ring spring to drive the blade-operating-ring in a clockwise direction.

Besides serving to hook the blade-operating-ring spring, though, the post on the blade-operating ring has a second purpose — it disengages the pallet at the end of the exposure. With the blades closed, the post comes against the pallet-control lever, Fig. 30. Here, the post holds the pallet-control lever in a clockwise direction to disengage the pallet from the star wheel.

As the blades open, the post moves away from the pallet-control lever, Fig. 31. Now the spring-loaded pallet-control lever swings counterclockwise. And the pallet moves into engagement with the star wheel (at the settings of 1/30 and bulb). Then, when the blade-operating ring rotates to the blades-closed position, the post again drives the pallet away from the star wheel.

Why disengage the pallet at the end of the exposure? Disengaging the pallet allows the retard lever to move quickly to its ready position. If it weren't for the pallet-disengaging feature, the retard lever would take over a second to move from the position shown in Fig. 25 to that shown in Fig. 24. And, if you happened to release the shutter before the retard lever had reached the ready position, you'd get a short exposure.

To remove the speeds escapement, first cock the shutter. Now locate the two screws which hold the speeds escapement, Fig. 32. One of the two screws has a long head; the top of the head is almost flush with the top of the speeds escapement. Remove both screws.

Next grasp the control pin of the retard lever with your tweezers. And lift the speeds escapement out of the shutter. As you're lifting up the speeds escapement, you may have to move the retard-lever control pin toward the outside of the shutter. The retard lever then turns to clear the lip of the lens flange.

With the speeds escapement removed, you have a better view of the blade-operating-ring spring, Fig. 33. Notice how the long end of the blade-operating-ring spring hooks against

the post on the blade-operating ring. The short spring end hooks to the threaded portion of a screw. This screw is one of the four screws holding the mechanism plate to the shutter housing.

You might now try cocking the shutter while watching the action of the leaf lever. Note how the leaf lever drags against the tab on the blade-operating ring during the cocking cycle. If it weren't for the blade-operating-ring spring, the leaf-lever action would open the shutter blades.

Want proof? Check the action for yourself by disconnecting the long end of the blade-operating-ring spring — let the spring end rest against the inside of the shutter housing. Now watch the blades as you cock the shutter. Note how the leaf lever pushes the blade-operating ring in a clockwise direction, opening the shutter blades. So, if you encounter a Gauthier-type shutter in which the blades open during the cocking cycle, you know where to look for the problem — the blade-operating-ring spring.

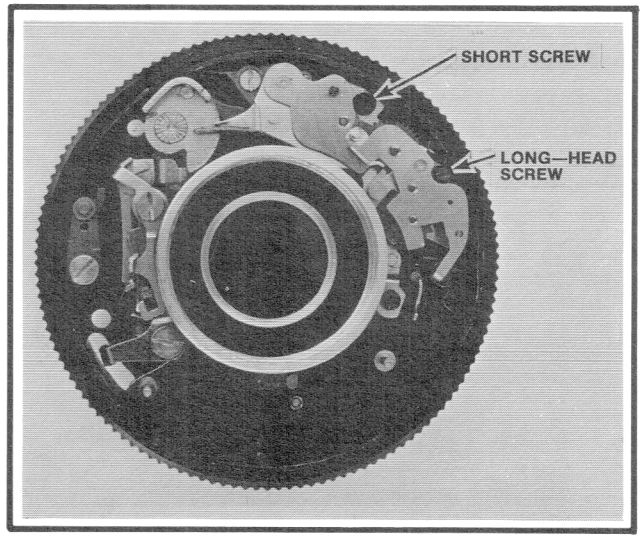


Figure 32

OPERATION OF THE FLASH CONTACTS

Reconnect the long end of the blade-operating-ring spring to the post on the blade-operating ring. Now take a look at the flash contacts, Fig. 33. These are the contacts that fire a flash unit when the shutter blades reach the full-open position.

The flash contacts consist of a contact blade and a contact pin, Fig 33. When the contact blade touches the contact pin, the flash fires. Locate the contact-closing lever above the contact blade, Fig. 33. The long, thin end of the contact-closing lever fits within a notch in the top of the blade-operating-ring tab (the same tab that the leaf lever engages).

Watch the contact-closing lever as you release the shutter. As the blade-operating ring rotates clockwise, it drives the contact-closing lever against the contact blade. In turn, the contact-closing lever pushes the contact blade against the contact pin, Fig. 34.

For now, you don't have to be too concerned about the flash-contact operation — you'll cover flash synchronization later in your course. Just be aware that the flash contacts should close when the blades reach the full-open position.

You can check the flash-contact adjustment by allowing the main-lever shaft to rotate slowly in the release direction. Stop the main-lever shaft the moment the contact blade touches the contact pin — the blades should now be fully open. And if they're not? You can then bend the contact blade to make the adjustment.

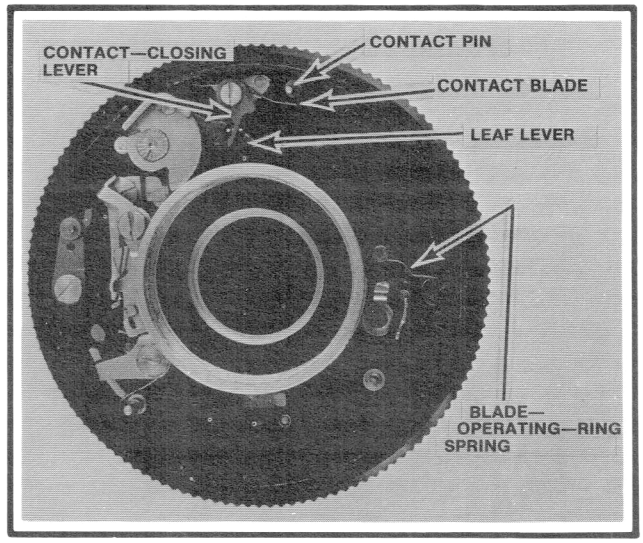
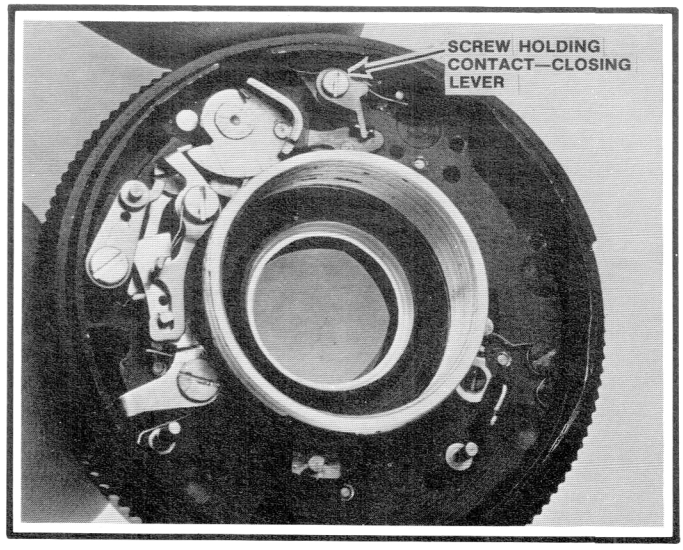


Figure 33

Figure 34



TEST-YOURSELF QUIZ #3

1. What part in the Pronto latches the main lever in the cocked position? Inner release lever
2. With the Pronto in the released position, what part holds the retard lever against the tension of the retard-lever spring? main lever
3. With the speed-control cam removed, the Pronto retard lever has its max (maximum, minimum) stroke.

4. During bulb operation, what part keeps the Pronto bulb lever engaged with the main lever? shutter release lever
5. The delayed-action escapement in the Gauthier-type shutter prevents the blades from opening by blocking the
   a. blade-operating ring b. main lever
6. What part disengages the delayed-action lock lever to release the delayed-action escapement in the Pronto? blade oper. ring
7. The function of the blade-operating-ring spring in the Pronto is
   a. To close the shutter blades during the release cycle
   b. To keep the blades from opening during the cocking cycle
8. What part in the Pronto disengages the pallet at the end of a pallet-controlled shutter speed? main blade opening
9. Using a separate piece of paper, draw a cycle-of-operations of the speeds escapement (remember, you don't have to show individual gears). Include all the parts which come into contact with the speeds escapement.

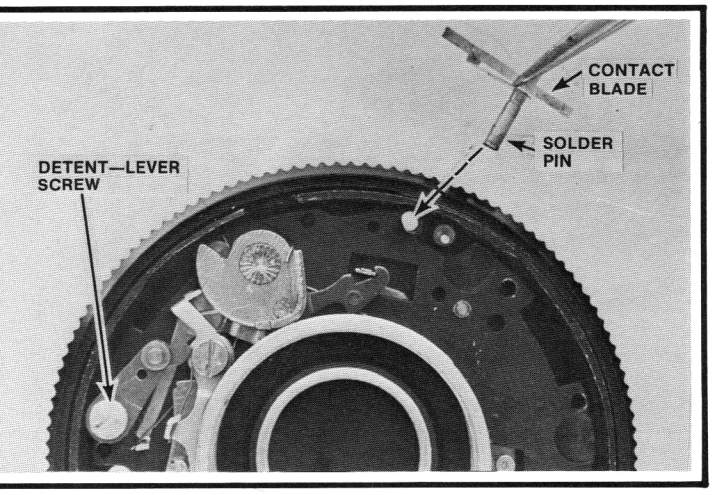


Figure 35

COMPLETING THE SHUTTER DISASSEMBLY

Let's now proceed through the shutter disassembly. We'll cover the normal disassembly for a routine cleaning and lubrication of the shutter. But there are some sections you wouldn't normally disassemble — unless you have to replace parts. In most repairs, you would not take out the main lever. Nor would you disassemble the diaphragm.

So, for your lesson requirements, you don't have to disassemble the main lever or the diaphragm. However, we'll cover the procedures in later topics. You can then use your lesson text for future reference.

Begin the disassembly by removing the screw holding the contact-closing lever, Fig. 34. Lift out the contact-closing lever and the loose brass bushing; the brass bushing fits between the contact-closing lever and the contact blade.

Now lift out the contact blade, Fig. 35. Note the long pin that's riveted to the contact blade; the pin passes through the mechanism plate and the shutter housing. The end of the pin provides one of the solder points for the flash wires; the other wire connects to the contact pin, Fig. 8.

For a routine cleaning, you wouldn't normally remove the bulb lever and the two release levers. However, it's recommended that you remove these parts from your practice shutter — both for a better understanding of the operation and for practice in handling shutter parts. First remove the detent lever by taking out its shoulder screw, Fig. 35.

NOTE: To facilitate reassembly, always keep screws and washers with their associated parts. For example, lay the screw that holds the contact-closing lever next to the contact-closing lever. And lay the detent-lever screw next to the detent lever.

Now disconnect the long end of the bulb-lever spring from the control tab of the bulb lever, Fig. 36. You may have already noticed one slight variation between the illustrated shutter and your practice shutter. In some models, the bulb-lever control tab is a separate piece which is riveted to the bulb lever; the shutter shown in Fig. 22 has this type of bulb lever. Other shutters use a one-piece bulb lever. However, the two styles will interchange.

To remove the bulb lever, unscrew its shoulder screw, Fig. 36. Watch for a loose spacer washer that sits under the bulb lever. If you're careful, you can lift out the bulb lever, the bulb-lever spring, the shoulder screw, and the spacer all as one unit.

Next locate the two springs for the release levers, Fig. 37. The spring for the inner-release lever coils around a threaded post (the post that supports the bulb lever). You don't have to remove the spring for the inner-release lever.

The outer-release-lever spring coils around the support post for the outer-release lever. One end of the spring hooks to a mechanism-plate post; the other end hooks to a tab on the side of the outer-release lever, Fig. 37.

Disconnect the long end of the outer-release-lever spring from the mechanism-plate post. Then remove the screw that holds the outer-release lever. Lift out the outer-release lever and the outer-release lever spring, Fig. 38.

It's a little more difficult to remove the inner-release lever; that's because the inner-release lever sits partially under the main lever. But you can still remove the inner-release lever without taking out the main lever.

First disconnect the long end of the inner-release-lever spring (the end that hooks to a notched tab on the inner-release lever), Fig. 38. Now rotate the main lever to the cocked position. You'll have to hold the main lever fully counterclockwise to uncover the inner-release lever. With its spring disconnected, the inner-release lever won't latch the main lever.

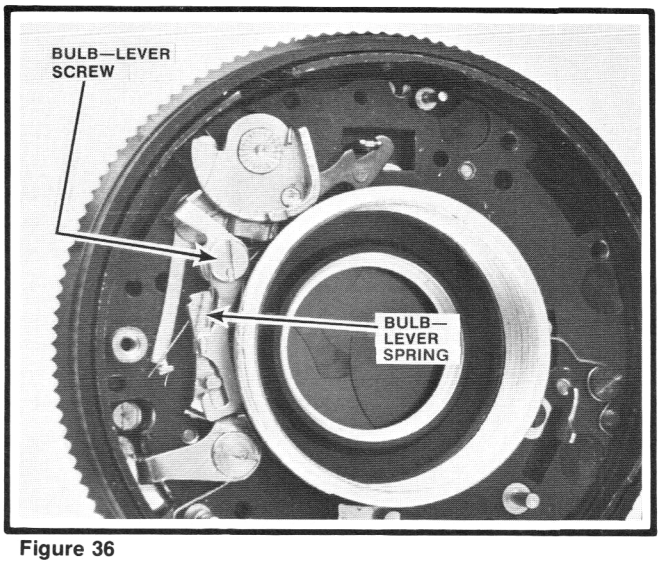


Figure 36

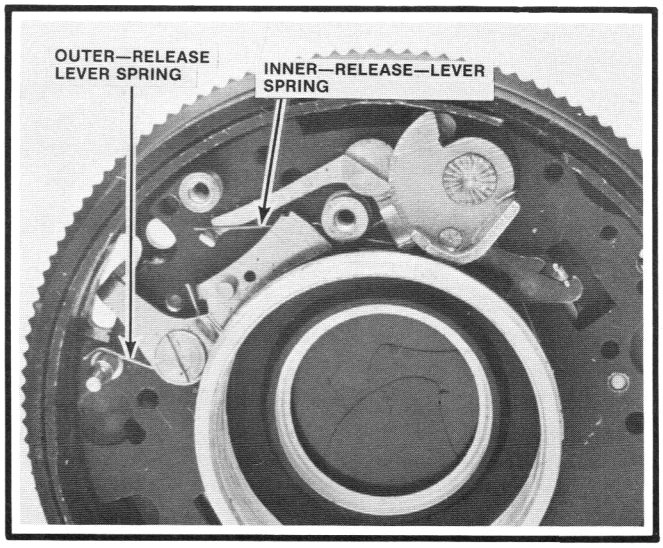


Figure 37

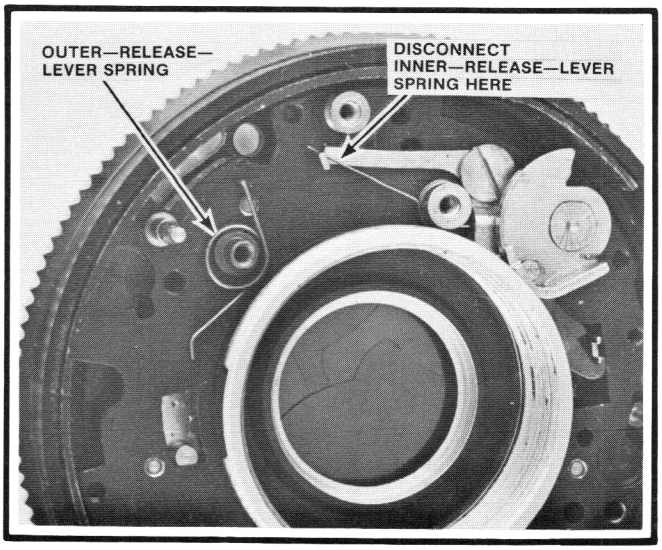


Figure 38

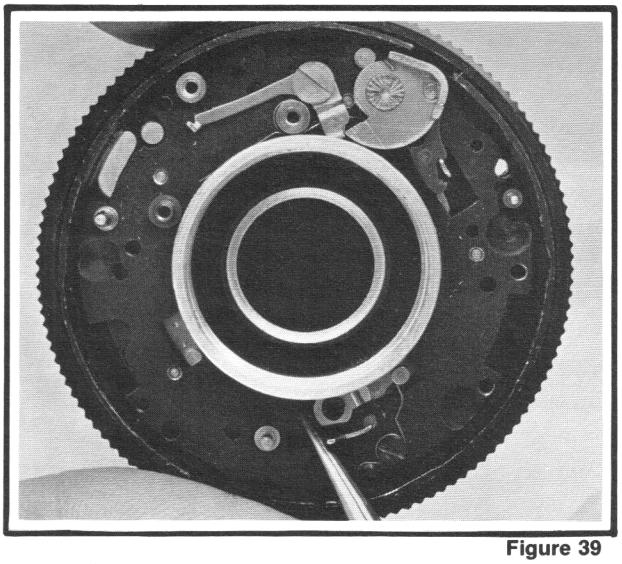


Figure 39

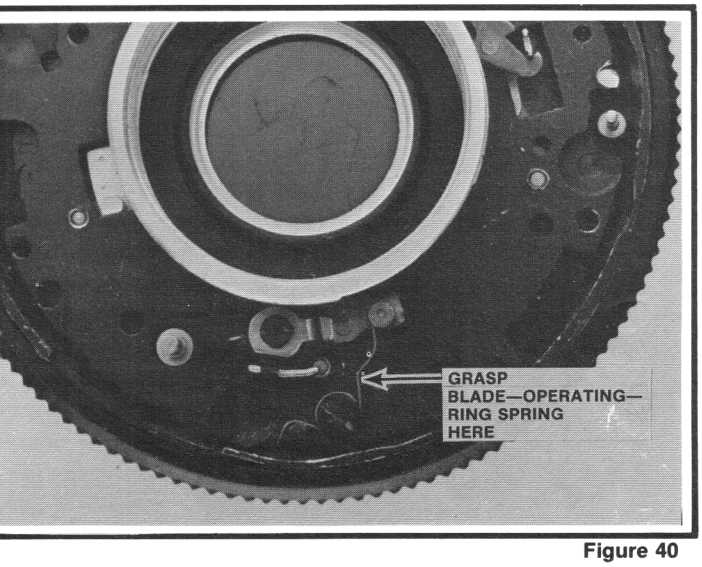
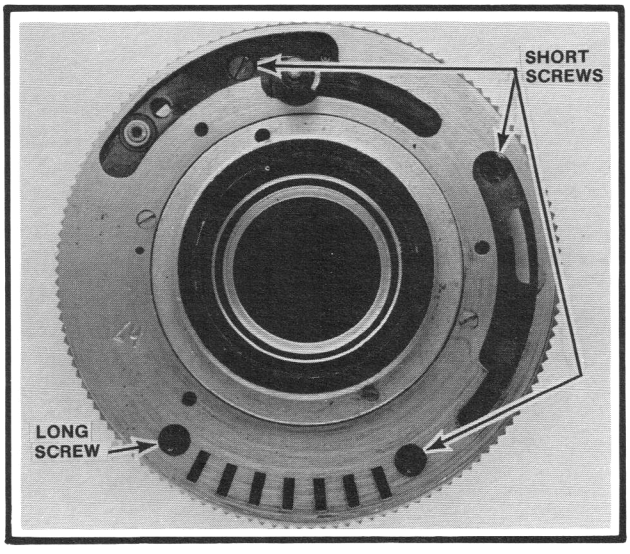


Figure 40

Figure 41



Here's one technique you can use — after cocking the main lever, place your finger or tweezers against the blade-operating-ring tab as shown in Fig. 39. Blocking the blade-operating ring prevents the main lever from rotating. Now remove the screw holding the inner-release lever. And lift the inner-release lever from the shutter.

Leave the inner-release-lever spring in place. The short end of the inner-release-lever spring may sit under the end of the leaf-lever spring. If so, it's difficult to remove the inner-release-lever spring without distorting it. The best time to remove the inner-release-lever spring is after you've taken out the main lever.

You should now be familiar with the procedures for removing the two release levers. But, unless you have to replace parts, you can normally leave the release levers in place. Also, with the inner-release lever removed, portions of the remaining disassembly are a little more difficult. Why? Because the main lever won't stay in the cocked position.

So, to facilitate the remaining disassembly, you may now wish to replace the two release levers. First install the inner-release lever. Remember, you must hold the main lever in the cocked position to seat the inner-release lever and install the screw.

Tighten the inner-release-lever screw. Then check to make sure the inner-release lever moves freely. Get into the habit of always checking the freedom of a moving part after you tighten the retaining screw. Now connect the long end of the inner-release-lever spring to the notched tab of the inner-release lever, Fig. 38.

Next seat the outer-release-lever spring as shown in Fig. 38. Seat the outer-release lever over its post (on top of the outer-release-lever spring). Then replace the screw.

Check now to assure that the outer-release lever moves freely. If so, connect the two ends of the outer-release-lever spring — connect the short end to the tab on the outer-release lever and then connect the long end against the mechanism-plate post, Fig. 37.

REMOVING THE SHUTTER BLADES

Some technicians attempt to clean the shutter blades without disassembly. But, as far as cleanliness is concerned, the shutter blades and the blade-operating ring are the most critical parts in the shutter. Unless you have an ultrasonic or agitation-type cleaning machine, you should remove the shutter blades for proper cleaning.

First remove the blade-operating-ring spring, Fig. 40. Disconnect the long spring end from the post on the blade-operating ring. Allow the long end to rest against the inside of the shutter housing.

Notice that the coil of the blade-operating-ring spring sits under a screwhead on the mechanism plate, Fig. 40. But you don't have to remove the screw. Just use your tweezers to grasp the long spring end near the screwhead as indicated in

Fig. 40. Then gently work the blade-operating-ring spring up and over the screwhead.

Next turn the shutter upside down to reach the four mechanism-plate screws. The mechanism-plate screws hold the mechanism plate to the shutter housing. If your shutter has a metal diaphragm-setting ring, you can reach all four mechanism-plate screws at once. Rotate the diaphragm-setting ring until its two round clearance holes are over screwheads, Fig. 41.

Remove all four mechanism-plate screws. But note the position of the long screw. Remember, the threaded end of the long screw serves to connect the blade-operating-ring spring.

If your shutter has the black plastic diaphragm-setting ring, you can't uncover all four mechanism-plate screws at the same time. First rotate the diaphragm-setting ring to uncover the screw at a 2 o'clock position in Fig. 42. Remove the screw. Then rotate the diaphragm-setting ring until the two round clearance holes uncover screwheads. And remove the remaining three screws.

Be sure to keep the shutter upside down. With the mechanism plate loose, the shutter blades can slip out of place. All five blades will be loose once you separate the mechanism plate from the shutter housing.

You may have to turn the diaphragm-setting ring slightly until its cutout clears the main-lever shaft. Then lift the shutter until you can grasp the lens flange from the front. And carefully lift the housing up and off the mechanism plate. If you were careful to avoid turning over the shutter, all five shutter blades should still be in position, Fig. 43.

In the Pronto, the five shutter blades are identical to one another. So, on reassembly, it makes no difference which blade you install first. However, the positions of the shutter blades are critical in some shutters. One or more of the blades may have cutouts to clear certain parts. Also, some shutters have loose spacers above and/or below the shutter blades to reinforce the pivot points. Consequently, it's a good habit to carefully examine the positions of the shutter blades.

Now lift out the top shutter blade, Fig. 43. Remember to avoid touching the shutter blades with your fingers — always use tweezers. Fingerprints will quickly etch their way into the metal. (If you do accidentally touch a shutter blade with your finger, refer to the text section, "Cleaning Tips"). Lift out the remaining four shutter blades in counterclockwise rotation.

With all five blades removed, you can examine the blade-operating ring, Fig. 44. The blade-operating ring fits into a track at the back of the mechanism plate. Five screws (the screws that serve as pivots for the blades) and washers hold the blade-operating ring.

You can remove the blade-operating ring without taking out the screws and washers. Locate the five semicircular cutouts in the outer circumference of the blade-operating ring, Fig. 44. By aligning the cutouts with the washers, you can lift out the blade-operating ring.

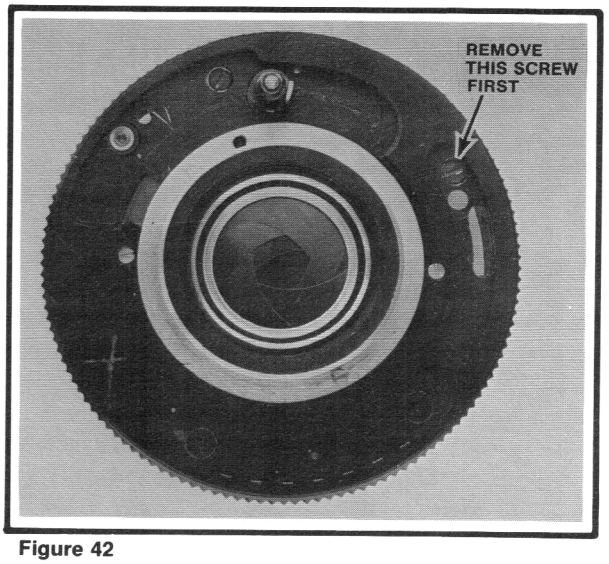


Figure 42

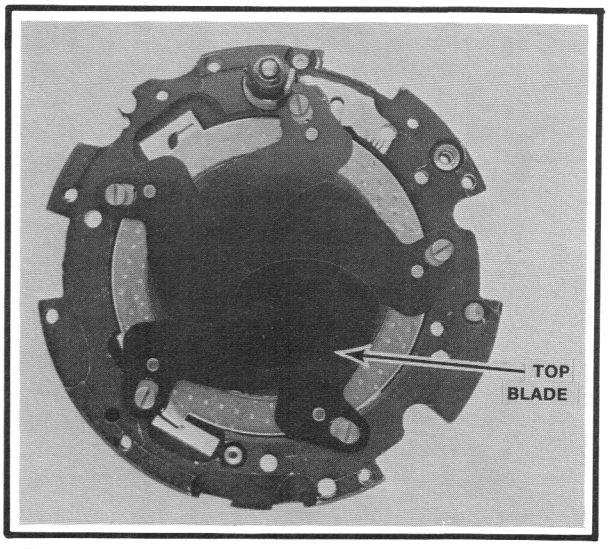
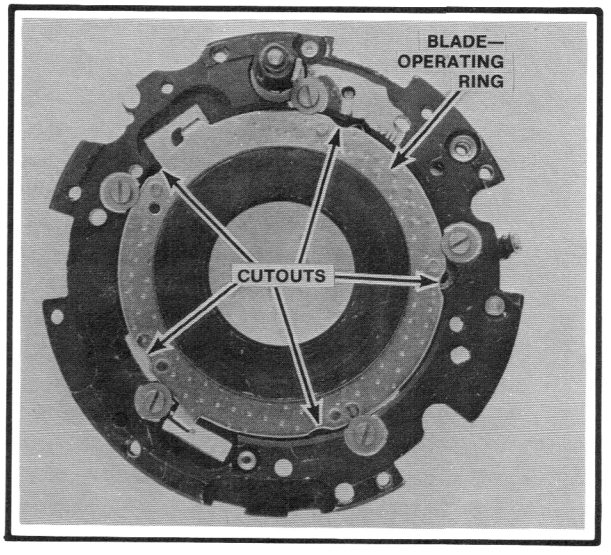


Figure 43

Figure 44



To align the cutouts with the washers, you must rotate the blade-operating ring to its fully counterclockwise position (as seen from the bottom, Fig. 44). But one part now prevents you from rotating the blade-operating ring fully counterclockwise — the stop plate on the other side of the mechanism plate, Fig. 45. During normal operation, the stop plate prevents the blade-operating ring from rotating too far counterclockwise — so far that the cutouts align with the washers.

Remove the stop plate by taking out its screw. Now cock the main lever. Hold the leaf lever disengaged from the tab on the blade-operating ring, Fig. 45. And rotate the blade-operating ring fully clockwise (as seen from the front of the mechanism plate — fully counterclockwise as seen from the back of the mechanism plate).

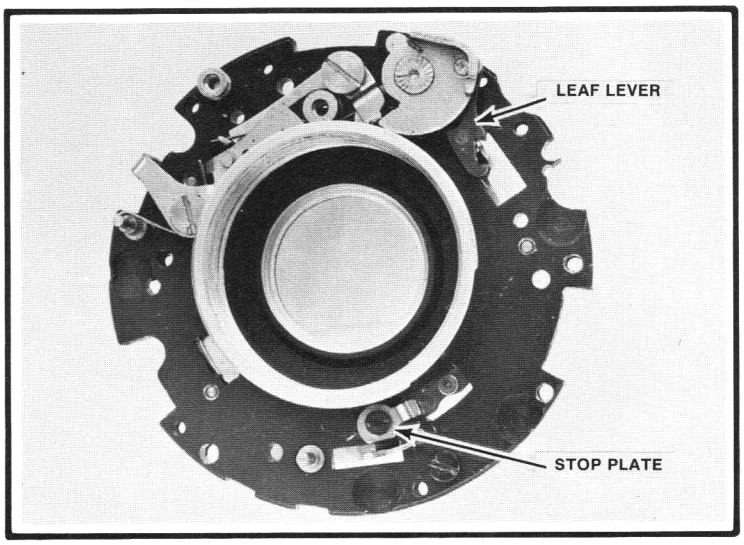


Figure 45

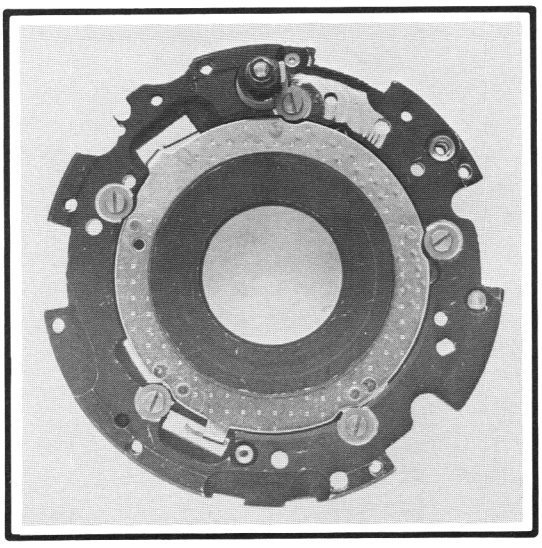


Figure 46

The five cutouts in the blade-operating ring should now align with the washers, Fig. 46. Here, you can lift out the blade-operating ring.

NOTE: Not all Gauthier-type shutters have the cutouts in the blade-operating ring. You must then remove the five screws and washers at the back of the mechanism plate. The holes in the washers are slightly larger than the diameter of the screw threads. So, on reassembly, it's possible to shift the washers in position. Before tightening the screws, shift the washers toward the outer edge of the mechanism plate. The smaller area of each washer then faces the blade-operating ring. This precaution assures that the pins of the blade-operating ring won't strike the edges of the washers.

CLEANING TIPS

As mentioned earlier, it's critical that the shutter blades and the blade-operating ring are clean. If there's dirt around these fast-moving parts, the shutter-speed accuracy will suffer — especially the accuracy of the fastest speed. A slow 1/250 second provides good evidence that the shutter needs cleaning.

You aren't required at this point in your program to clean and lubricate the practice shutter. However, we'll describe a procedure for your reference and future use. The cleaning technique we'll cover involves two steps. First, you use a solvent to loosen and suspend the dirt. Then you use a drying procedure that removes both the solvent and the dirt carried by the solvent. It takes both steps to properly clean the parts.

Clean each of the five shutter blades individually. Just dip each blade in a clean solvent that leaves no residue — for example, the clear-colored watch-rinsing solution that comes with your course. Then dry each blade with an absorbant tissue such as Kimwipes. As you dry each blade, the Kimwipe carries off the solvent and the suspended dirt.

When the blades are clean, they'll appear uniformly black. Any residue left as a result of insufficient cleaning or drying will appear as a spot. In that event, repeat the cleaning procedure.

NOTE: The colored watch-cleaning solution you receive should be reserved for use in cleaning only extremely dirty and/or greasy parts. Use of this solution should always be followed by a rinse in the clear watch-rinsing solution.

Never use the colored cleaning solution on plastic parts. It can have a detrimental effect on the finish of some types of plastic such as the cover plate and diaphragm-setting ring on the Pronto shutter.

Also clean the blade-operating ring and the track in the mechanism plate. Moisten a Kimwipe with the solvent. Then wipe the parts with the moistened Kimwipe. Dry the parts by wiping them with a clean Kimwipe.

You can clean the remaining small metal parts by swishing them in the solvent. Then dry each part individually with a clean Kimwipe. Alternately, you can blow dry the parts with a hand blower. Clean the larger parts with a solvent-moistened Kimwipe.

The two escapements take a little more time to clean. That's because you clean the escapements as complete units. To clean the speeds escapement, swish the complete unit in the solvent. Then work the retard lever a few times — push the retard lever against the resistance of the escapement and allow the retard lever to return on its own. Working the

retard lever gets the solvent into the gear teeth and pivot points. Finally, use a hand blower to blow out the solvent. The solvent carries the suspended dirt with it.

Use a similar technique to clean the delayed-action escapement. Work in the solvent by actuating the delayed-action setting lever. Move the delayed-action setting lever to the cocked position; then hold the lock lever disengaged and move the delayed-action setting lever to the released position. Again blow dry the escapement.

LUBRICATION TIPS

There are several general rules you can apply to lubricating any blade-type shutter:

1. Never use an oil lubricant. The oil may work its way to the shutter blades. Oil causes the blades to stick together.
2. Use a grease lubricant on sliding, rubbing, and latching parts. It takes only a tiny, hardly visible amount of grease to do the job.
3. Do not lubricate fast-moving parts — for example, the blade-operating ring and the shutter blades. Leave these parts dry.
4. Lubricate the escapements in blade-type shutters with a dry lubricant such as dry-moly. Dry-moly (molybdenum disulfide) is a powder that works its way into the pores of the metal. It's similar to graphite, but it doesn't have the abrasive characteristics of graphite.
5. Never lubricate a dirty surface. The lubrication may seem to restore proper operation. But the effect is temporary. Lubrication won't stay on a dirty surface.

To lubricate the escapements, you can work the dry-moly into the pivot points and the gear teeth. Put some dry-moly on the plates of the escapements at the bearing positions. Then use a cotton swab or a Kimwipe to rub the dry-moly into the pivot points. For the gear teeth, spray some dry-moly inside the escapement. Actuate the retard lever (or the delayed-action setting lever) a few times to work in the dry-moly. Then use your hand blower to blow out the excess.

CAUTION: In actual repair practice it is absolutely essential that you remove (blow away) all the loose granules of dry-moly. Even the smallest trace of loose granules can float around inside the shutter mechanism and eventually end up on an internal lens surface.

For the other lubrication points, there are several acceptable types of grease. Some technicians prefer the white silicon grease. Others use the black moly-lube (moly suspended in grease). Your training program includes a recommended shutter grease you can use for all the grease-lubrication points in a shutter.

The following checklist notes the grease-lubrication points in the Gauthier-type shutter. You may wish to refer to the checklist as you reassemble the Pronto.

1. After installing the blade-operating-ring spring, lubricate the surface of the long coil that comes against the blade-operating-ring post.
2. Lubricate the latching surface of the main lever (the surface engaged by the bulb lever and the inner-release lever).
3. Lubricate the cam edge of the leaf lever that drags against the forked tab of the blade-operating ring.
4. Lubricate the edge of the outer-release lever that comes against the inner-release lever.
5. Lubricate the end of the retard-drive lug on the main lever (the end that strikes the retard lever).
6. Lubricate the edges of the speed-control cam that come against the detent lever, the pallet-control tab, the bulb-control tab, and the retard-lever control pin.

REPLACING THE SHUTTER BLADES

Before you seat the blade-operating ring, check the position of the leaf-lever spring — make sure the long spring end connects behind the post on the underside of the leaf lever, Fig. 45. If the leaf-lever spring has slipped to the front of the post, first cock the main lever.

CAUTION: With the mechanism plate removed, be careful that you don't overcock the main lever — that is, rotate the main lever too far past its latching point with the inner-release lever. Normally, the shutter housing limits the main-lever overtravel; the lug on the main lever comes against the shutter housing to limit the counterclockwise rotation. If you now rotate the main lever too far counterclockwise — further than necessary for proper latching by the inner-release lever — you may damage the mainspring.

With the main lever cocked, you can position the leaf-lever post to the front of the leaf-lever spring, Fig. 45. Leave the main lever in the cocked position to install the blade-operating ring.

Seat the blade-operating ring with its five cutouts aligned with the five washers, Fig. 46. Remember, the forked tab on the blade-operating ring passes through the slot near the main-lever shaft. Make sure that the blade-operating ring seats under all five washers.

Now hold the leaf lever againt the lens flange. And rotate the blade-operating ring counterclockwise (as seen from the front of the mechanism plate) until its forked tab hooks within the leaf-lever notch, Fig. 45. Then replace the stop plate, Fig. 45.

You can check the freedom of the blade-operating ring by holding the leaf lever disengaged from the forked tab. Place your thumb against the large blade-operating-ring tab (the tab that comes against the first-gear segment of the delayed-action escapement). Now rotate the blade-operating ring back and forth. The blade-operating ring should move very freely.

If everything checks properly, you're ready to install the five shutter blades. The main lever should be in the released position (to make sure the main lever doesn't accidentally release while you're installing the blades). Seat the first blade in the position shown in Fig. 47. Notice that the slot in the blade fits over the screwhead; the hole in the blade fits over the pin on the blade-operating ring.

Also note that the blade, Fig. 47, is in the closed position. If you accidentally seat the blade upside down, it will be in the open position. Replace the remaining four shutter blades in clockwise rotation.

Now hold the mechanism plate — with the blades up — by the lens flange. And seat the housing over the back of the mechanism plate. Remember that the main-lever shaft must pass through the hole in the housing. You may have to slightly rotate the diaphragm-setting ring to clear the hole.

With the housing fully seated, replace the four mechanism-plate screws. The long screw, you'll recall, goes at the position indicated in Fig. 48. You can then turn over the shutter assembly to replace the blade-operating-ring spring.

Seat the coil of the blade-operating-ring spring over the screwhead, Fig. 40. Make sure the short end of the blade-operating-ring spring hooks to the long mechanism-plate screw. Connect the long end of the blade-operating-ring spring to the post of the blade-operating ring.

Test the operation by first cocking the shutter — the blades should not open. Now release the shutter. The blades should snap open and shut.

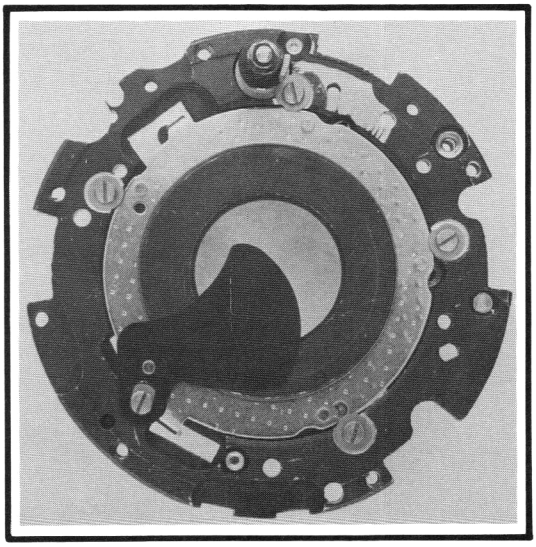


Figure 47

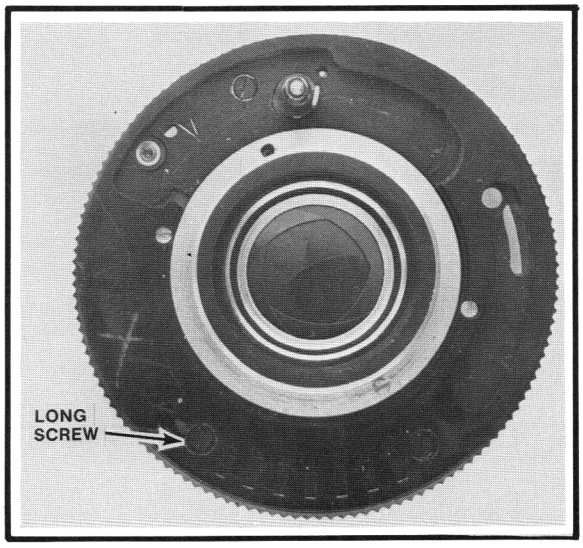


Figure 48

MAIN-LEVER OVERTRAVEL

At this point in the reassembly, you can also check the main-lever overtravel. "Overtravel" refers to how far a part travels beyond its latching point. With the main lever, we're talking about how far the latching surface travels beyond the inner-release lever during the cocking stroke.

Try cocking the shutter and holding the main-lever shaft fully advanced, Fig. 49. You can see that the main-lever latching surface travels beyond the latching surface of the inner-release lever. The main lever can rotate counterclockwise until its lug strikes the shutter housing.

Now allow the main lever to rotate clockwise until it's latched by the inner-release lever. The distance the main lever travels is the overtravel. With these experiments you can see that the main lever travels further than necessary during the cocking cycle. The additional rotation — the overtravel — assures that the inner-release lever always drops into positive engagement.

To measure the overtravel, again hold the main lever as far as it will go in a counterclockwise direction. Now measure the distance between the latching surface of the main lever and the tab of the inner-release lever, Fig. 49. The distance should be around 1.5mm.

However, if the shutter were mounted to the camera, there normally wouldn't be as much overtravel. The camera's wind mechanism may not rotate the main lever quite as far during the cocking stroke. So, to check for sufficient overtravel, you should really have the shutter mounted on the camera. You can then hold the camera's wind lever fully advanced. And check for a slight space gap between the latching surface of the main lever and the tab of the inner-release lever.

What if the overtravel is insufficient? The inner-release lever may then fail to engage the main lever. And the shutter releases as soon as you allow the wind lever to return.

The adjustment point for the overtravel is the latching tab on the inner-release lever. By bending the the tab toward or away from the main lever, you can change the overtravel. For example, suppose you found insufficient overtravel with the shutter mounted on the camera. You could then hold the wind lever fully advanced. And bend the tab on the inner-release lever away from the latching surface of the main lever.

If you bend the tab too far, though, the main lever will have excessive overtravel. In that case, the main lever returns too far in a clockwise direction before being latched by the inner-release lever. The main lever may even rotate so far clockwise that it starts to open the shutter blades.

You can check for excessive overtravel with the shutter in the cocked position. Note the position of the leaf lever, Fig. 50 — there should be a slight space gap between the driving edge of the leaf-lever notch and the tab of the blade-operating ring. That is, the inner-release lever should engage the main lever **before** the leaf lever engages the blade-operating-ring tab.

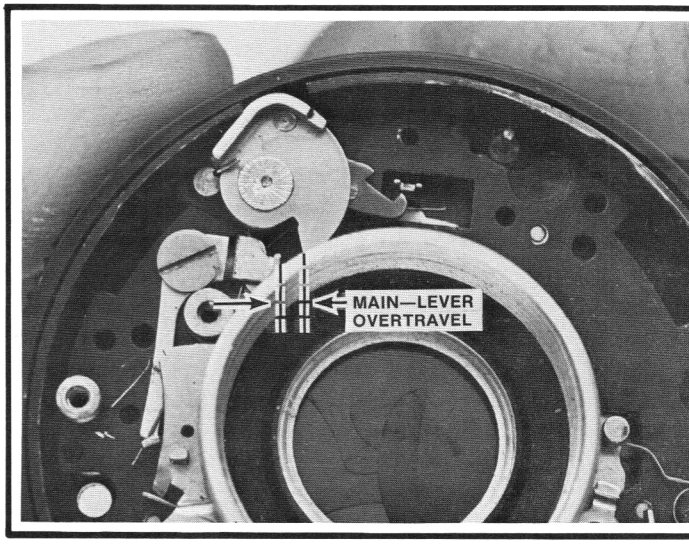


Figure 49

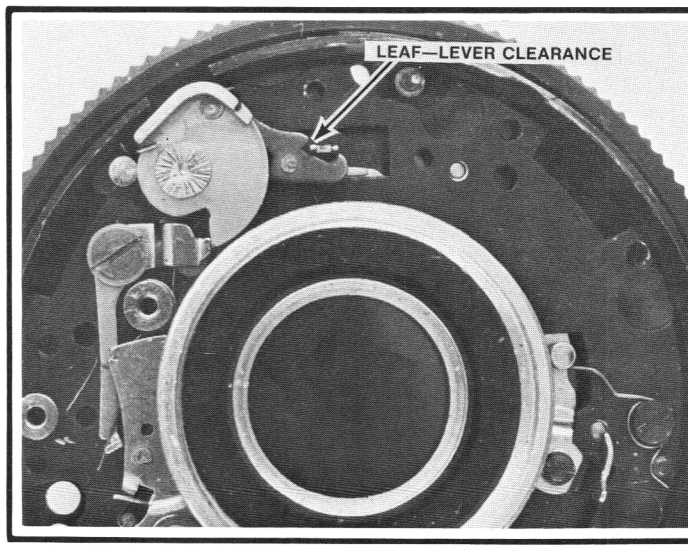


Figure 50

COMPLETING THE REASSEMBLY

The remaining reassembly of the Pronto is the reverse of the disassembly. We'll outline the steps here along with the precautions.

1. Cock the shutter. Now place the bulb-lever spacer on top of the threaded post. Seat the bulb-lever spring over the hole in the bulb lever and replace the screw. Test the bulb lever for freedom of movement. Then hook the long end of the bulb-lever spring against the bulb-lever control tab, Fig. 51.
2. Seat the contact blade, Fig. 51. Place the brass bushing on top of the contact blade (over the screw hole). Then replace the contact-closing lever with its long tail seated within the notch of the blade-operating-ring tab, Fig. 51. Replace the screw and check for proper operation. Remember, the contact-closing lever should drive the contact blade against the contact pin when the blades reach the full-open position.
3. Replace the detent lever, Fig. 51.
4. Cock the shutter. Then seat the speeds escapement. You may have to move the retard lever slightly to clear the lens flange. Now, to make sure the speeds escapement seats fully, push the pallet-control tab, Fig. 52, toward the outside of the shutter. The lower tab of the pallet-control lever then seats counterclockwise of the post on the blade-operating ring. When you're sure the speeds escapement is fully seated, replace the two screws. Test the operation by releasing the shutter.
5. Seat the delayed-action escapement with the hole through the first-gear segment over the mechanism-plate post. You may have to turn the first-gear segment to clear the lens flange (remember, you can turn the first-gear segment in the release direction if you hold the delayed-action lock lever disengaged). When the delayed-action escapement is fully seated, cock and release the shutter — the blades should not open, but the blade-operating-ring tab should hold the

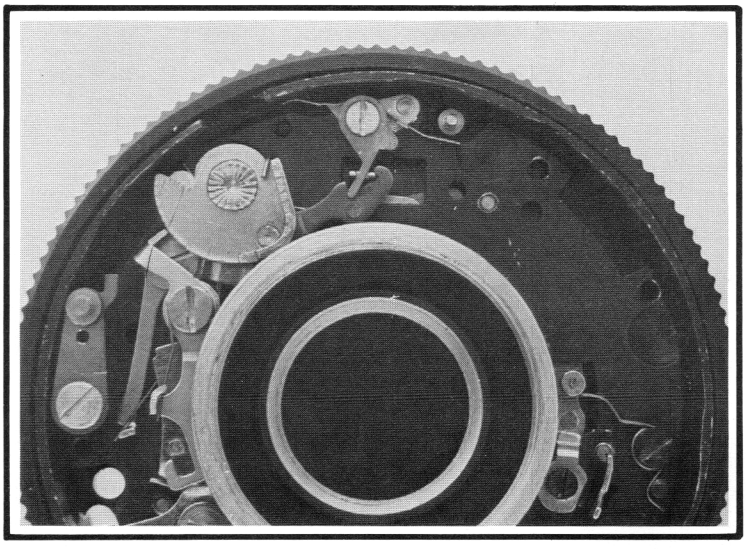


Figure 51

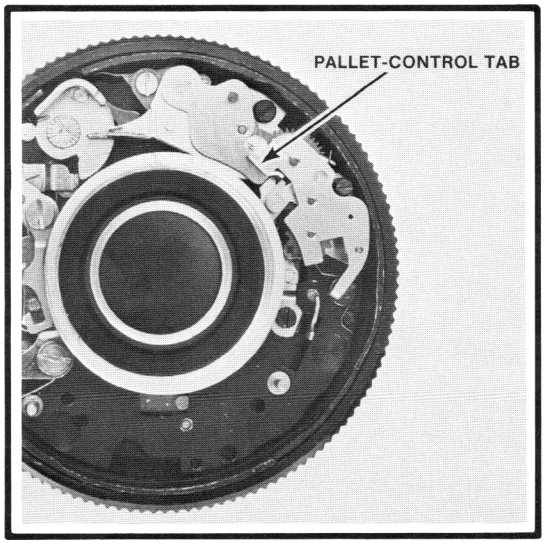


Figure 52

delayed-action lock lever disengaged. Now turn the delayed-action setting lever in the release direction (counterclockwise) until the shutter releases.

6. Position the delayed-action drive spring as shown in Fig. 53. Note the position of the loop that hooks to the first-gear segment — the loop points to the outside of the shutter. This position allows the straight section of the delayed-action drive spring to lie against the lens flange.

7. Slip the coiled section of the delayed-action drive spring under the lip of the lens flange, Fig. 54. Now slide the delayed-action drive spring from left to right until you can connect it to the pin on the first-gear segment. Connect the delayed-action drive spring to the first-gear-segment pin.

8. Grasp the loop at the coiled end of the delayed-action drive spring with your tweezers. Pull the delayed-action drive spring from right to left, tensioning the coils, until you can hook the loop over the mechanism-plate post. Make sure that the loop hooks within the post groove (around halfway up the post). Test the operation of the delayed-action escapement.

9. Thoroughly check all functions of the shutter.

10. Replace the detent-lever spring.

11. Make sure the shutter is in the released position. Then position the speed-control cam so that the large section of the bulb-lever control slot is over the bulb-lever control tab. Seat the speed-control cam as far as it will go. Then, working through the detent-lever slot in the speed-control cam, insert the points of your closed tweezers into the detent-lever hole. Pull the detent lever toward the outside of the shutter until the speed-control cam seats fully. Check the shutter operation at all settings.

12. Seat the thin spacer on top of the speed-control cam. Remember that the two locating holes in the spacer must fit over the locating pins in the shutter (the pin on the speeds escapement and the end of the mechanism-plate post that connects the delayed-action drive spring). If the locating holes won't align with the pins, the spacer is upside down.

13. Replace the cover plate. Make sure that the cover-plate locating slots also key over the locating pins.

14. Be very careful to avoid cross-threading the aluminum scalloped retaining ring. Since the scalloped retaining ring is very thin, it's easily cross-threaded. Screw on the scalloped retaining ring until the speed-control cam has around the same amount of pressure as you noted prior to disassembly. Then turn the half-head locking screw to hold the scalloped retaining ring.

15. Thoroughly check all functions of the shutter.

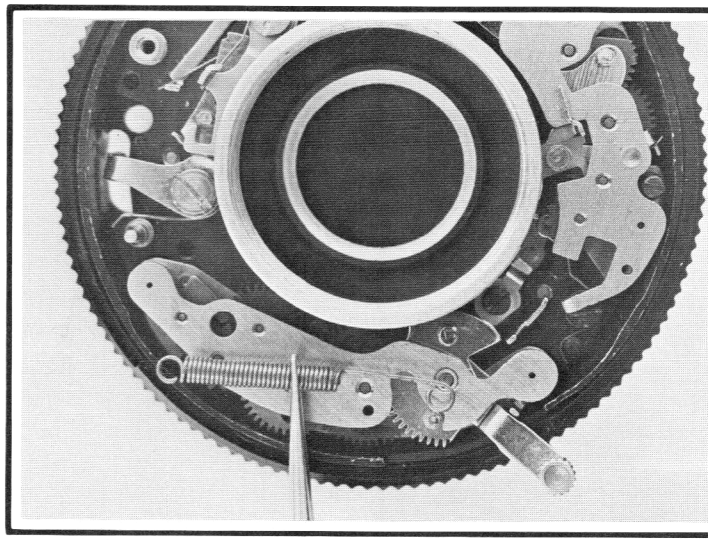


Figure 53

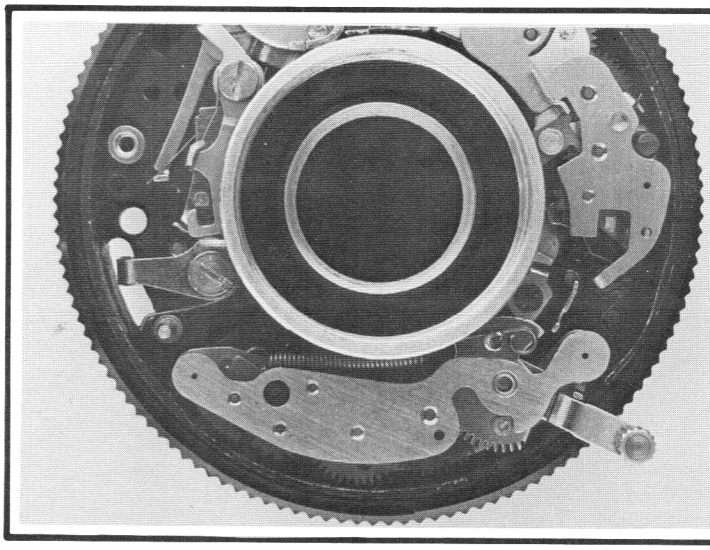


Figure 54

REMOVING THE MAIN LEVER

As indicated earlier, most repairs don't require removing the main lever. But you will have occasion to remove the main lever in Gauthier-type shutters. The most common reason? Replacing the mainspring.

Suppose that you've cleaned and lubricated the shutter. Yet, when you test the shutter speeds, you find that the fastest speed is too slow. In that case, suspect a fatigued mainspring.

You may find that replacing the mainspring is the only way to bring in the fastest shutter speed — even though the mainspring looks good. Later you'll learn how to test and adjust shutter-speed accuracy. But keep in mind that the fastest speed is the most difficult to obtain. All parts must be clean, properly lubricated, and in good condition to bring in the top speed.

With some Gauthier-type shutters, replacing the mainspring requires a minimum amount of disassembly. The Gauthier-type shutter with an external setting lever uses a screw to hold the main lever, Fig. 55. You can then remove the main lever without separating the mechanism plate from the shutter housing.

But other shutters, like the Pronto, are designed to be operated by the camera controls. As you've seen, a shaft at the back of the main lever extends through the shutter housing. A clip at the back of the mechanism plate holds the shaft.

It may then be necessary to remove the mechanism plate. Fig. 56 shows the clip holding the main-lever shaft in the Pronto. To remove the main lever, first use your needle-nose or parallel-jaw pliers to unscrew the nut, Fig. 56. Lift off the black collar and the cocking cam, also shown in Fig. 56.

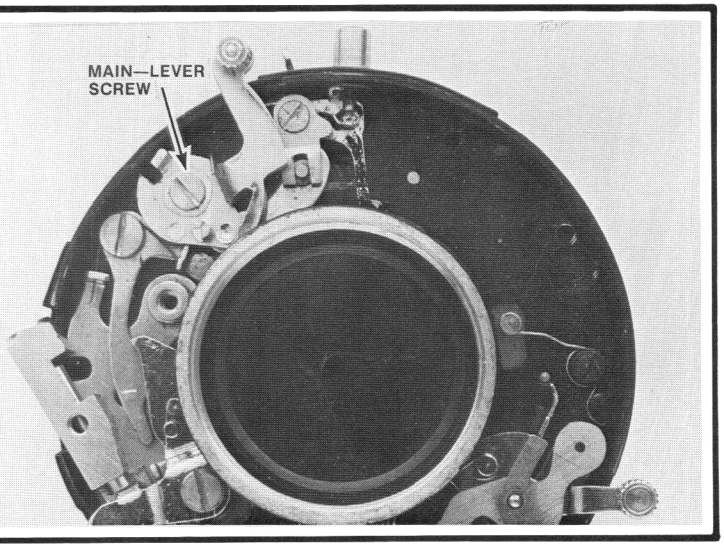


Figure 55

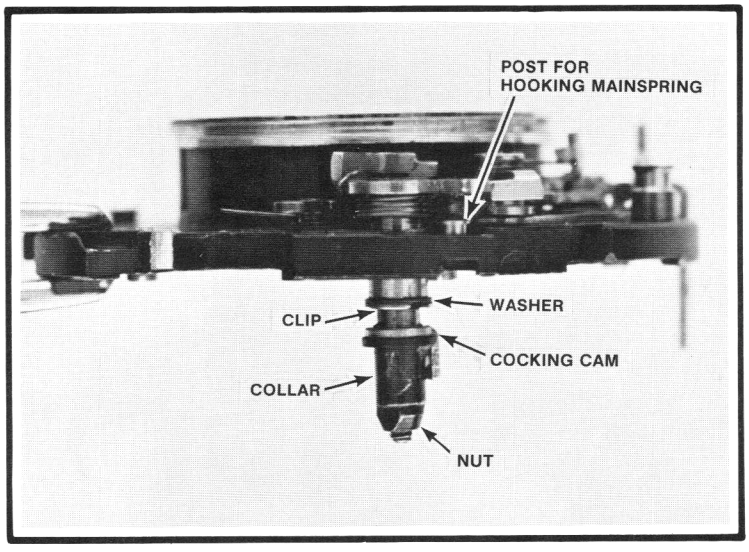


Figure 56

You can now reach the clip holding the main-lever shaft, Fig. 57. Many other shutters and cameras use similar clips to hold parts in position. Because of the shape, the clip is commonly called an "E-clip" or an "E-ring."

The jaws of the E-ring have a springlike action to grip the main-lever shaft. Because of the springlike action, you must be very careful when removing the E-ring to avoid loss. E-rings have a way of springing across the room during removal.

If you look closely, you can see that the E-ring clips into a groove around the main-lever shaft. Insert a small tool, such as a small screwdriver, between the main-lever shaft and the closed end of the E-ring. Keep one finger in contact with the E-ring to prevent loss. Now carefully pry the E-ring out of the groove in the main-lever shaft. Note the loose washer that fits between the E-ring and the brass bushing. Lift out the washer.

Only the mainspring now holds the main lever in place. One end of the mainspring hooks to the lug on top of the main lever; the other end hooks behind a post on the mechanism plate, Fig. 56. Push up the main-lever shaft from the bottom until you can disconnect the mainspring from the mechanism-plate post. Lift out the main lever together with the mainspring.

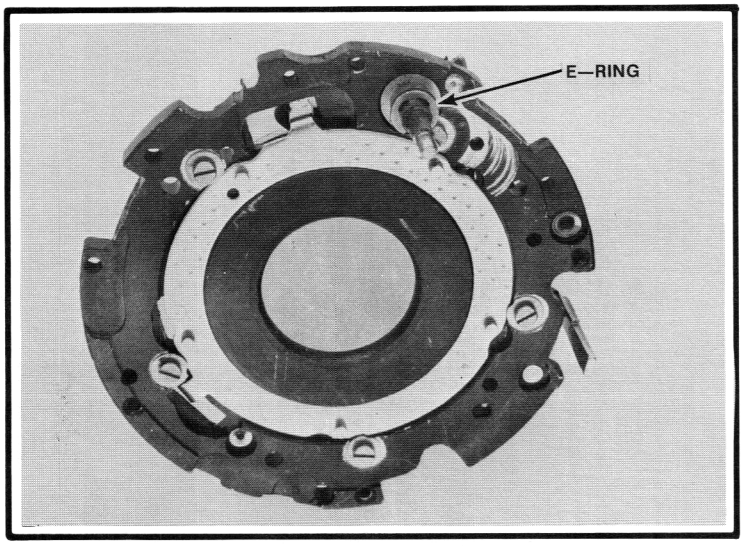


Figure 57

REPLACING THE MAINSPRING

The mainspring seats around the brass bushing, Fig. 58. But now, with the main lever removed, the leaf-lever spring comes against the bushing. So, to get the leaf-lever spring temporarily out of the way, connect it behind the blade-operating-ring tab as shown in Fig. 59.

Now seat the mainspring over the bushing, Fig. 60. Notice that the straight end of the mainspring goes down and connects clockwise of the mechanism-plate post. The tricky part of reassembly comes next — connecting the top end of the mainspring to the main lever.

One technique is to loop a wire over the hooked end of the mainspring as shown in Fig. 61. After seating the main lever, you'll be able to pull the hooked end of the mainspring into position by using the wire loop. Partially seat the main lever. Then use the wire loop to pull the hooked end of the mainspring in a counterclockwise direction.

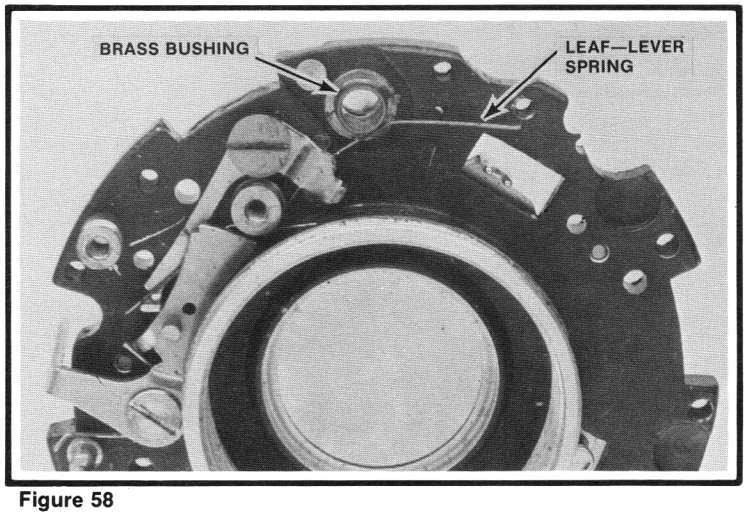


Figure 58

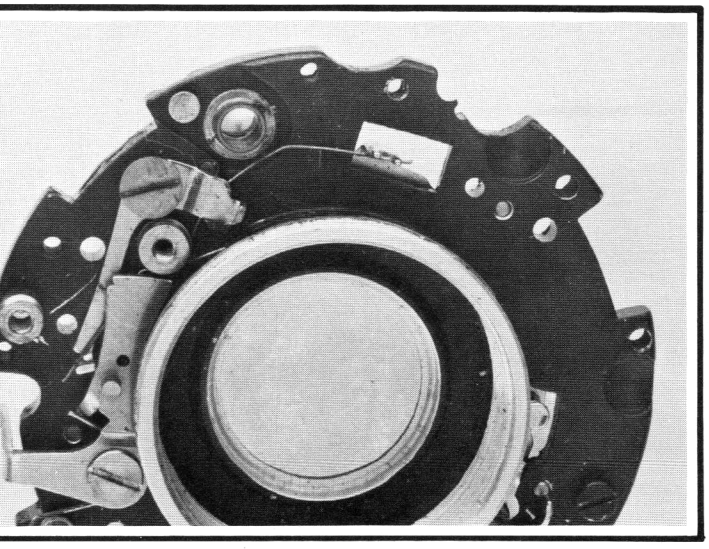


Figure 59

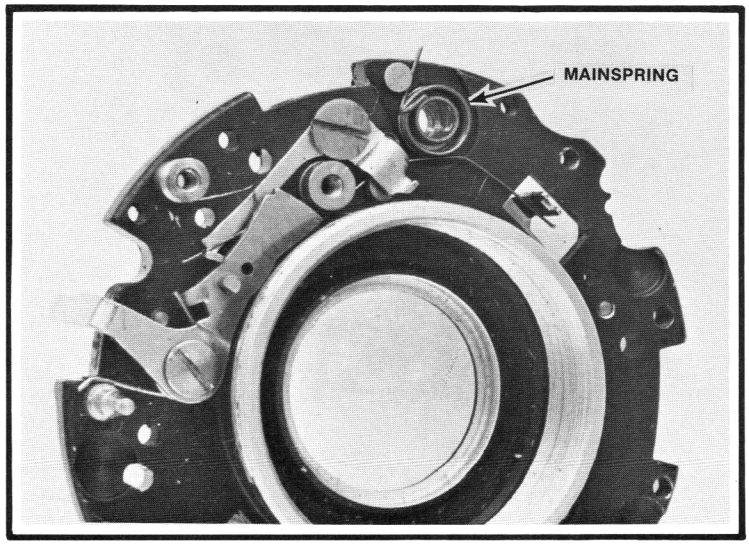


Figure 60

Still using the wire loop, connect the hooked end of the mainspring to the back of the main-lever lug, Fig. 62. Then slip the loop off the mainspring. Both ends of the mainspring should now be properly connected. And you can fully seat the main lever.

Rotate the main lever with your finger to assure free movement. You can tell when the main lever is fully seated by looking at the portion of the shaft that extends to the other side of the brass bushing, Fig. 63. You should be able to see the groove for the E-ring.

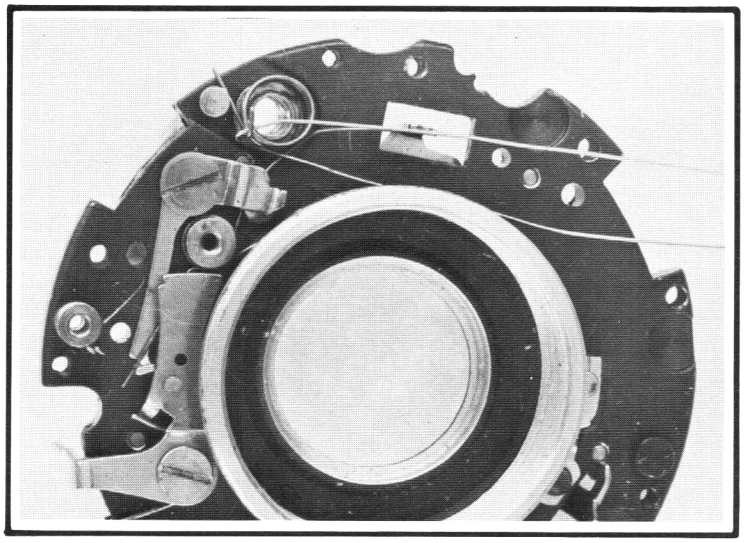


Figure 61

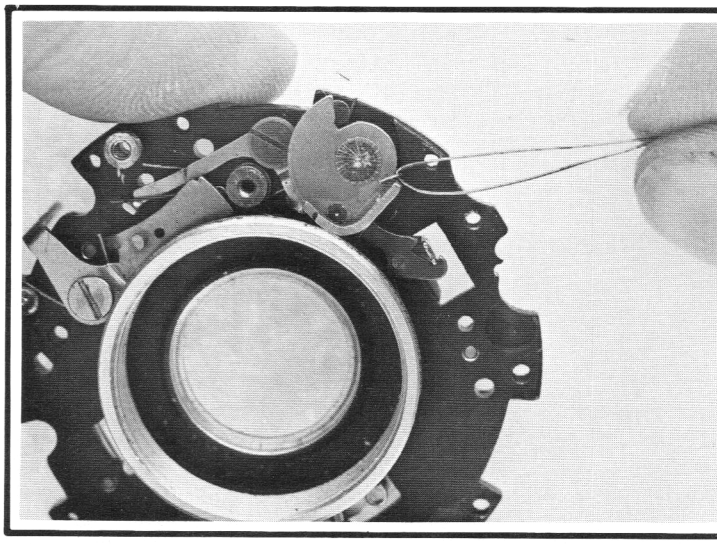


Figure 62

If you can't see the groove, the main lever isn't fully seated. Try rotating the main lever toward the cocked position as you apply slight downward pressure. Also, check to see if a mainspring coil has slipped between the main lever and the brass bushing. If it has, use your tweezers to probe the coil into place as you push down the main lever.

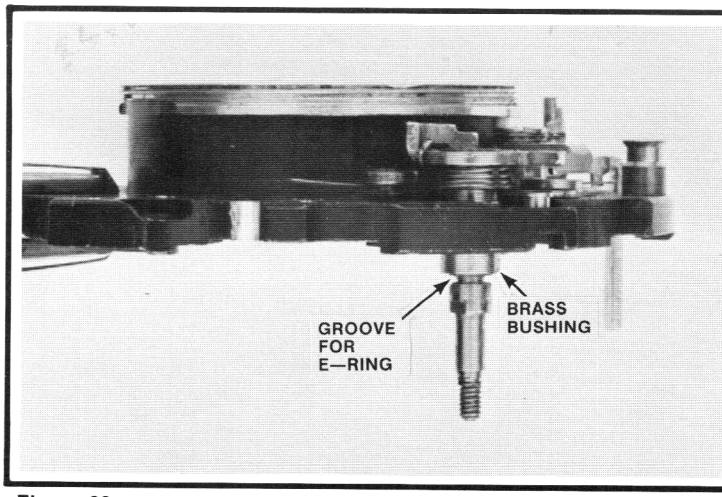


Figure 63

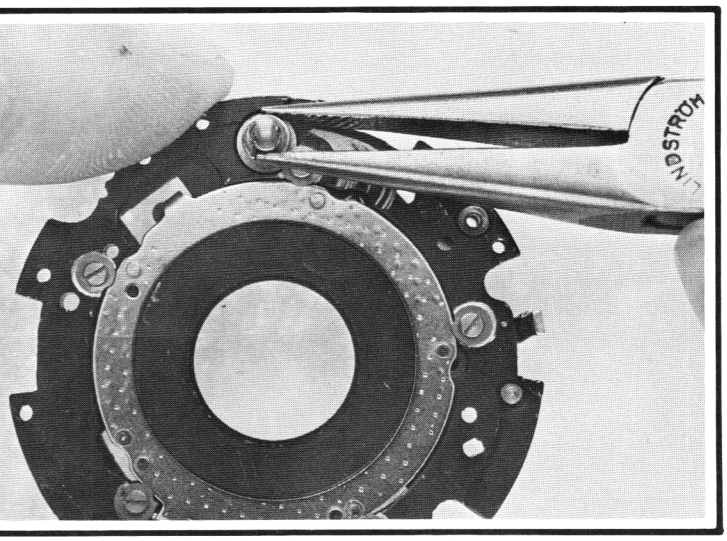


Figure 64

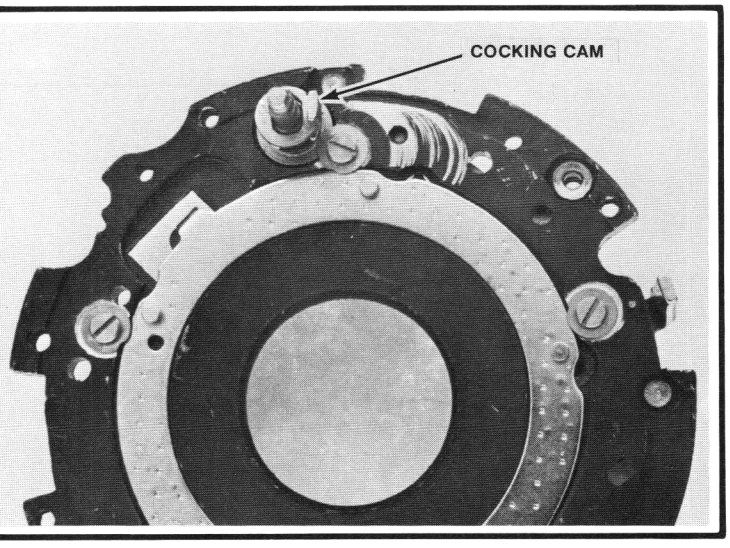
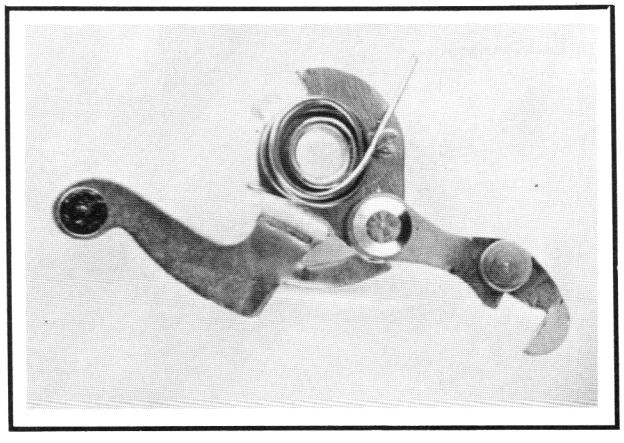


Figure 65 Shutter released

Figure 66



Then, when you're sure the main lever is fully seated, slip the washer over the main-lever shaft. Make sure the washer sits over the shoulder formed by the shaft and the bushing — below the groove for the E-ring. Next start the open end of the E-ring into the groove. It takes some pressure to snap the E-ring into place. Fig. 64 shows one technique. Place one jaw of your needle-nose pliers against the closed end of the E-ring; place the other jaw against the main-lever shaft. Then gently but firmly squeeze the pliers closed. The pliers will force the E-ring into place.

Seat the cocking cam over the main-lever shaft as shown in Fig. 65. The hole in the cocking cam has two flat sides; these sides key to two flat surfaces on the main-lever shaft. Make sure that the cocking cam is fully seated over the flatted section with its tab positioned as shown in Fig. 65.

Now slip the collar over the main-lever shaft. A cutout in the base of the collar keys over the tab of the cocking cam. As you install the nut, be sure to hold the main lever. Otherwise, you may force the main lever to rotate in the cocking direction as you tighten the nut. Turning the main lever too far in the cocking direction can damage the mainspring.

With some Gauthier-type shutters, it's possible to use a different technique for installing the mainspring — one you may find somewhat easier. The main lever may have a pin on the underside. You can use the pin to temporarily connect the straight end of the mainspring.

Fig. 66 shows the technique. Here, we've connected the hooked end of the mainspring to its normal hooking point on the main lever. We've then installed the initial tension and connected the straight end of the mainspring to the pin.

It's now possible to drop the main lever into position. As you seat the main lever, use your tweezers to work the straight end of the mainspring off the pin and against the mechanism-plate post.

With either technique, it's easier to install a new mainspring than it is to replace the original mainspring. The manufacturer supplies the replacement mainspring with an extra-long straight end. After you install the new mainspring, use a pair of sidecutters to clip off the extra length. Make sure that the mainspring end does not extend beyond the edge of the mechanism plate.

DIAPHRAGM INSTALLATION IN THE PRONTO

Like the shutter blades, the diaphragm leaves must be very clean to operate properly. A slight trace of oil on the diaphragm leaves will cause binding. In most cases, you'll only be disassembling the diaphragm for cleaning or for replacement of parts.

The cover plate, Fig. 67, holds the diaphragm leaves in place. Two screws hold the cover plate to the shutter housing. Before taking out the screws, it's a good idea to scribe the cover plate. Place one scribe line on the cover plate and a matching scribe line on the housing. You can then replace the cover plate in the proper rotational position without trial-and-error — just match your scribe lines.

Also scribe the cover plate to mark the positions of the two screws. Since there are several holes in the cover plate, marking the screw holes can save you time on reassembly.

Rotate the diaphragm-setting ring fully counterclockwise — the largest-aperture position. Now remove the two screws and lift off the cover plate. You can then see how the five diaphragm leaves interlace with one another, Fig. 68.

The pin on the top of each leaf passes into a hole in the cover plate, Fig. 67. Each leaf also has a pin on the underside. The bottom pins pass into the slots in the diaphragm-control ring, Fig. 68.

Also notice how the leaves are positioned with respect to one another. Each leaf has a wide end and a narrow end. The wide end of each leaf sits on top of the narrow end of the adjacent leaf.

You can lift out each leaf individually. Or you can simply turn the housing upside down and allow the leaves to fall onto your work surface. Clean the individual leaves using the same procedures as described earlier for shutter blades. As with shutter blades, be careful to avoid touching the diaphragm leaves with your fingers.

On reassembly, it makes no difference which leaf you install first. Nor does it matter what starting position you use. Just make sure that the diaphragm-setting ring is in the largest-aperture position (fully counterclockwise as seen from the top).

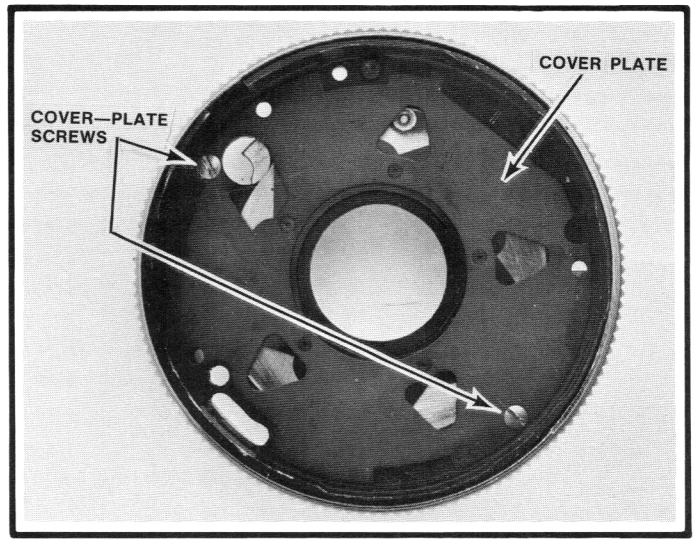
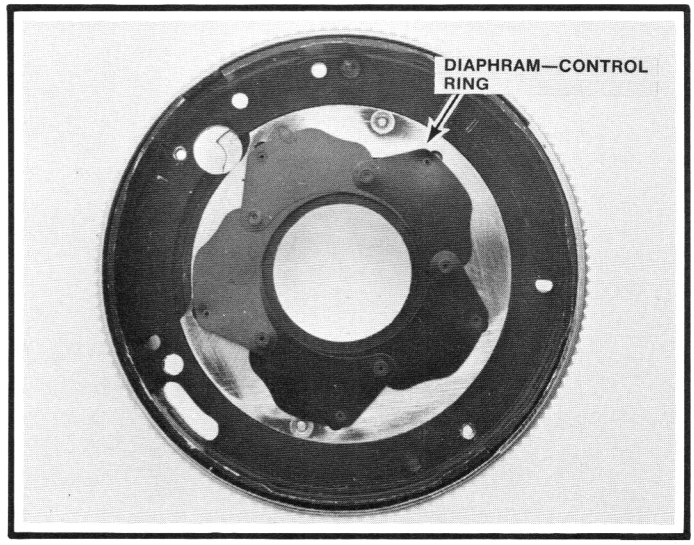


Figure 67

Figure 68



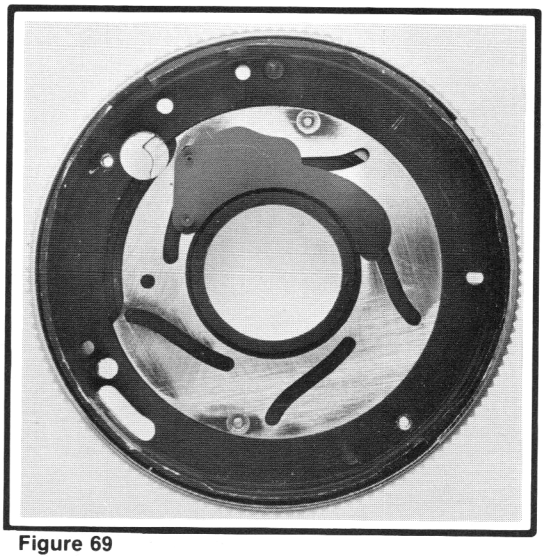


Figure 69

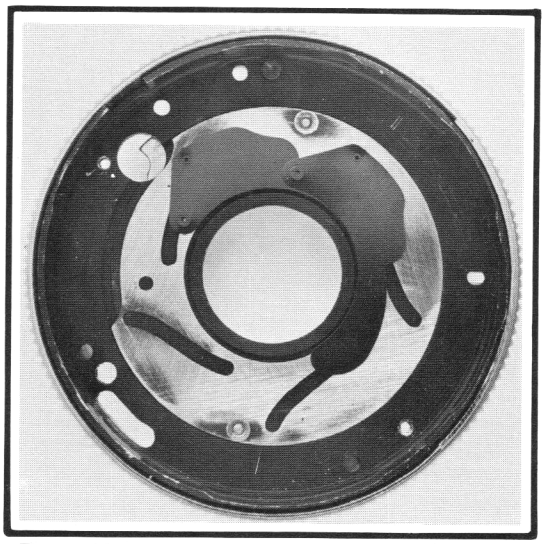
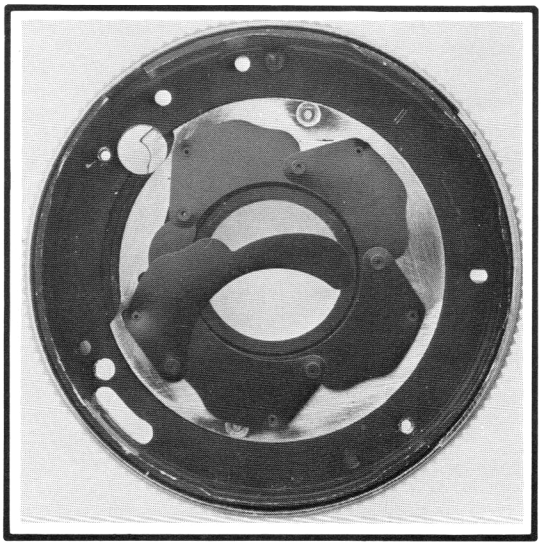


Figure 70

Figure 71



Now seat the first leaf as shown in Fig. 69. The downward-projecting pin must fit into the long slot in the diaphragm-control ring. Slide the leaf so that the pin is at the top of the slot, Fig. 69.

Seat the second leaf in the adjacent clockwise position, Fig. 70. The wide end of the second leaf then sits above the narrow section of the first leaf. Similarly, install the third leaf and the fourth leaf in clockwise rotation.

The fifth leaf is the most difficult one to install. Its tail — the narrow section — must fit under the wide section of the first leaf. Seat the fifth leaf as shown in Fig. 71. Then slide the tail of the fifth leaf toward the outside of the shutter housing. Make sure the tail passes under the first leaf.

When all five leaves are in place, seat the cover plate. Remember, the pins on the tops of the leaves must pass through the cover-plate holes. But you don't have to align all five pins as you seat the cover plate. Just place the cover plate in position with your scribe marks aligned. Then, working through the holes in the cover plate with closed tweezers, line up each pin.

There would rarely be occasion to diasssemble the shutter housing any further than we've described. However, if you ever have to remove the diaphragm-control ring, take out the two screws at the back of the shutter housing. These screws hold the diaphragm-control ring to the diaphragm-setting ring.

TEST-YOURSELF QUIZ #4

1. For a routine cleaning of the Pronto, which of the following parts would not normally be removed?
   a.blade-operating ring
   b.shutter blades
   (c) inner-release lever
   d.speeds escapement
2. One end of the blade-operating-ring spring hooks against the blade-operating ring. The other hooks against long mech. plate screw
3. What type of lubricant should never be used in a blade-type shutter? oil
4. What type of lubrication should you use for the gears and pivot points of the escapements? dry
   moly
5. Consider that a Gauthier-type shutter fails to remain in the cocked position — it releases as soon as you allow the cocking mechanism to return. T problem could be
   a.excessive main-lever overtravel
   (b.) insufficient main-lever overtravel
6. In the Pronto, what part would you adjust t correct for excessive main-lever overtravel? tab on inner release lever
   Toward the main lever



SUMMARY

SUMMARY, AND A LOOK AHEAD

You should now have a working knowledge of the Gauthier-type shutter. Remember that you can spot a Gauthier-type shutter by the main-lever design. In future lessons, you'll see the same design in the more-sophisticated Prontor shutter.

But, as you've learned, a Gauthier-type shutter isn't necessarily made by Gauthier. Rather, it can be any shutter that follows the same basic design. For example, Fig. 72 shows a Copal shutter mounted to the front standard of a popular twin-lens reflex. If you look closely, you can see that the Japanese-made Copal follows the same design as the German-made Pronto.

The shutter you've studied may also be used on a twin-lens reflex. But you'll encounter it more often on inexpensive 35mm rangefinder-type cameras. Blade-type shutters come in different sizes according to the camera type. The Pronto you've studied is the smallest size, designed primarily for 35mm cameras.

Shutter manufacturers designate the shutter sizes by a number system. The Pronto is a 00-size shutter; the mechanism plate measures around 44mm in diameter. The next larger size, the O-size shutter, has a mechanism plate measuring around 53mm in diameter. You'll find the O-size blade-type shutters on medium-format cameras. A larger size yet, the 1-size shutter, is used on large press and view cameras.

As you study the complex-escapement retards in coming assignments, you'll learn about the shutter-speed adjustments. The complex-escapement shutter has a more sophisticated speeds escapement to extend the shutter-speed range. But the other design features remain similar to what you've already learned. You'll also cover the second basic type of blade-type shutter — the Compur-type shutter.

The repair techniques you've learned in this assignment apply to other blade-type shutters. Remember that the shutter blades must be clean and dry (no lubrication) to work properly. Some technicians do rub dry-moly into the shutter blades, especially if the blades have wear marks or scratches. Dry-moly on the blades won't hurt the operation. But it will hurt the appearance — it'll give the blades a gray, rather than black, appearance. What should you do if the blades show signs of wear or other damage? It's best to replace the blades with a new set.

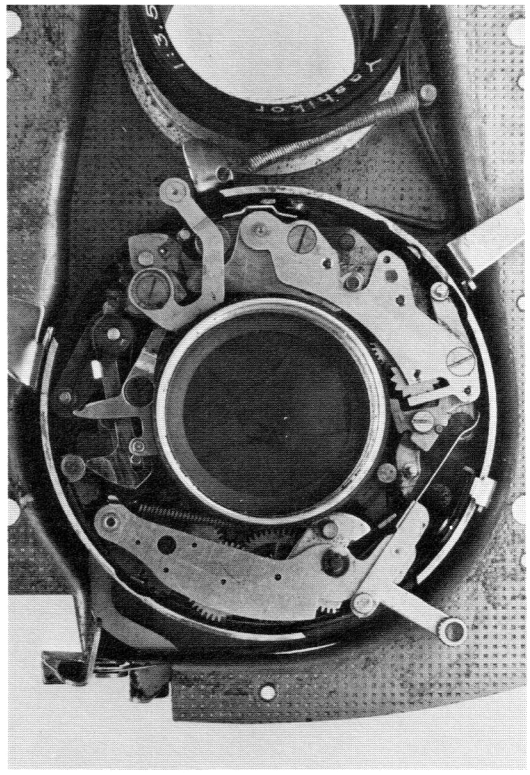
For your reference, this lesson has included some repair techniques beyond the routine — replacing the mainspring and removing the diaphragm leaves. Some technicians automatically replace the mainspring with every repair in a blade-type shutter (especially in shutters used on professional-quality cameras). Replacing the mainspring provides assurance that you'll be able to bring in the fastest shutter speed.

Diaphragm repairs are also covered in Servisheet 60027 (included with your lesson materials). However, you'll notice that the Servisheet shows a different type of diaphragm leaf. In your repairs of shutters and lenses, you'll encounter both leaf designs.

The type of leaf shown in the Servisheet maintains an opening that's almost perfectly round. But the type of leaf used in the Pronto also has an advantage — the diaphragm-setting ring rotates the same amount between all settings. For example, it takes the same amount of rotation to go from f/4 to f/5.6 as it does to go from f/11 to f/16.

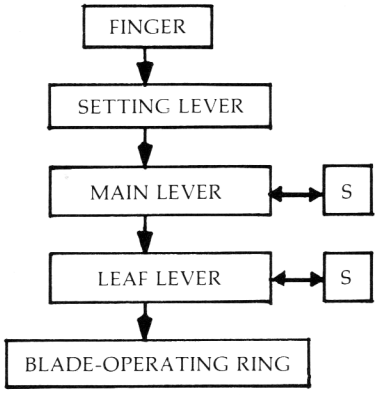
In the Pronto, you've also seen a typical set of flash contacts. And we described a visual test for the contact adjustment. The flash-synchronization system in many blade-type shutters is much more complex. So, before you learn about more involved flash systems, you should have a good understanding of circuit-test techniques. You'll learn about such techniques in your next two lessons covering photographic electricity.

Figure 72



ANSWERS

QUIZ #1

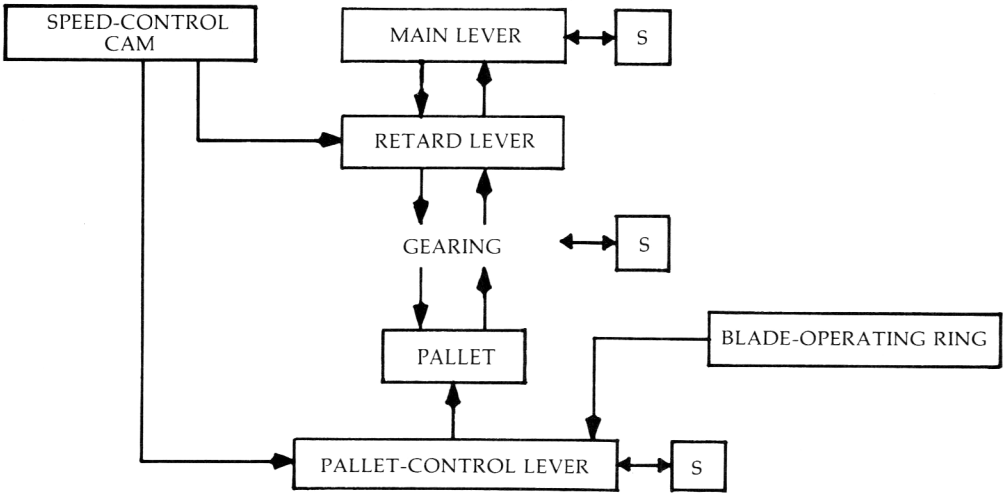
1. **Clockwise**. The Gauthier main lever rotates clockwise both to open and to close the shutter blades. The main lever opens the blades during the first part of its clockwise rotation; it closes the blades during the second part of its clockwise rotation.
2. **governor**, or **slow-speed governor**
3. **self-timer**, or **self-timer escapement**
4. The **mainspring** provides the power both to open and to close the shutter blades. The leaf-lever spring only holds the leaf lever against the tab on the blade-operating ring.
5. The delayed-action escapement applies its delay **before the blades start to open** for the self-timer feature.
6. 

QUIZ #2

1. Replace the speed-control cam at the **bulb** setting. The shutter should be **released.**
2. The retard lever moves into position to intercept the main lever during the **cocking cycle**. As you cock the shutter, you can see the pin on the retard-control lever move toward the center of the shutter.
3. The further the retard lever moves during the cocking cycle, the **more** the retard action. The retard lever then has a longer stroke. Consequently, the main lever remains engaged with the retard lever for a longer period of time.
4. The pallet moves into engagement with the star wheel during the **release cycle**. When you release the shutter, you can see the pallet-control tab jump toward the center of the shutter.
5. The slowest speed with the pallet disengaged is **1/60**.
6. The retard lever has its largest stroke at **1/60**.

QUIZ #3

1. The **inner-release lever** latches the main lever ir the cocked position.
2. The **main lever** holds the retard lever toward the center of the shutter. As the main lever rotates to the cocked position, it frees the retard lever. The retard-lever spring then moves the retard lever to the ready position.
3. The retard lever has its **maximum** stroke with the speed-control cam removed. Without the speed-control cam, there's nothing to restrict the travel of the retard-lever control pin.
4. At bulb, the pin on the **outer-release lever** keeps the bulb lever engaged with the main lever.
5. The first-gear segment of the delayed-action escapement blocks the **blade-operating ring** to prevent the blades from opening.
6. The **blade-operating ring** disengages the delayed-action lock lever.The blade-operating ring can rotate a slight distance before its tab strikes the first-gear segment. This slight rotation disengages the delayed-action lock lever.
7. The blade-operating-ring spring **keeps the blades from opening during the cocking cycle.**
8. A stud on the **blade-operating ring** disengages the pallet at the end of a pallet-controlled shutter speed.
9.



QUIZ #4

1. For a routine cleaning, you would not normally remove the **inner-release lever**. You can clean the part properly — as well as reach the lubrication points — without removing it.
2. The short end of the blade-operating-ring spring hooks to the **long mechanism-plate screw**.
3. You should never use **oil** in a blade-type shutter. Oil will work its way to the shutter blades.
4. In a blade-type shutter, lubricate the escapements with **dry-moly**. You can use oil to lubricate the escapements in focal-plane shutters. But oil should not be used in blade-type shutters.
5. If the main lever won't stay in the cocked position, its overtravel may be **insufficient.**
6. You can correct for excessive overtravel in the Pronto by bending the tab of the **inner-release lever** toward the main lever.